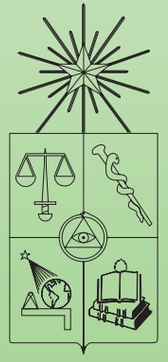

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ARTÍCULOS

UNIVERSIDAD DE CHILE
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ESTUDIOS DE ECONOMIA

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Intergenerational Transmission of Spousal Inequality*

Transmisión intergeneracional de desigualdades maritales

Kieu-Dung Nguyen**

Abstract

This paper studies whether sons and daughters reproduce in their relationships the same intra-household inequalities observed for their parents in terms of some economic statuses (wages, income, work hours, and education). Additionally, we emphasize the relevance of transmission of preference and gender-role attitude in investigating household issues. Utilizing the Panel Study of Income Dynamics' data we find that married sons imitate their parents' household disparities more than married daughters. For parents and their daughter's family, the similarity in household inequalities is insignificant. The paper also examines the differential patterns of the statuses and the dynamics of educational gap patterns across generations.

Key words: *Spousal inequality, income, education, labor supply, intergenerational mobility.*

JEL Classification: *J12, J62, D10.*

Resumen

Este trabajo analiza si los hijos e hijas reproducen en sus relaciones las mismas desigualdades en el hogar que se observan en sus padres en términos de estatus económico (salarios, ingresos, horas trabajadas y educación). También se enfatiza la relevancia de la transmisión de preferencias y actitudes específicas al

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género. Usando un panel de dinámica de ingresos, encontramos que los hijos imitan más las disparidades de los padres que las hijas. El trabajo también examina la dinámica de los patrones de brechas educacionales entre generaciones.

Palabras clave: *Desigualdad marital, ingreso, educación, oferta laboral, movilidad intergeneracional.*

Clasificación JEL: *J12, J62, D10.*

1. Introduction

Economic literature has recognized the crucial role of intra-household (or spousal) inequality in theories of intra-household resource allocation, social income distribution, as well as intergenerational mobility for decades. Chiappori & Meghir (2014) stated that inequality relates to poverty and investment in children, which implies the intergenerational transmission of poverty. They insisted that it is necessary to pay more attention to intra-household inequality from theoretical and empirical perspectives. Understanding intra-household inequality, and more broadly intra-household allocations, is necessary to estimate the impact of policies and programs on poverty alleviation, expanding the question from those who benefit directly from the policies and programs to child poverty and child development more generally.

What are the factors responsible for the inequality of economic status between spouses? Besides individual and household characteristics and social environment, the parental disparity in economic status emerges as a potential determinant of the inequality. How does the parental income gap influence that gap of their offspring's family? And how does a "marrying-down" father affect his son's decision to marry a less educated woman? Psychoanalytic theory, based on Freud's work, has, for a long time, argued that people tend to marry a person who is similar to their opposite-sex parent. Sociological literature provides evidence that gender-role attitude and experiences play a determining role in shaping the attitude of their children, affecting their family formation and marital lives in adulthood (Platt & Polavieja, 2016). Economic studies recently also paid attention to the dynamics of preferences over generations. They recognized that preference-based explanations might offer both theoretical and empirical insights into human behavior.

This paper provides the first evidence on intergenerational transmission of within-household inequality. Concretely, it examines whether children reproduce in their own family the same intra-household inequalities observed for their parents regarding income, wages, work hours, and education. Although numerous past works investigated the transmission of economic statuses, none of them focused on transmitting the statuses' inequality, to our knowledge. These statuses are chosen because they are commonly used economic indicators. Non-unitary models concur that intra-household resource allocation is affected differently

by the husband's and wife's bargaining power. For example, wives with more negotiating power may distribute more significant resources to their children than their husbands. Spousal relative earnings, education, and labor supply can be used as proxies for their power (Chiappori, 1992; Lundberg & Pollak, 1996; Jensen, 2012). The spousal gaps in these economic statuses are good predictors of the household resource allocation between partners. Therefore our findings could imply that there is an intergenerational transmission of intra-household behaviors. There are several ways to estimate spousal earnings inequality (and also inequalities in other economic statuses) in a household: (i) the ratio of a wife's earnings to the combined earnings of both spouses; (ii) the ratio of the average earnings of females to that of males in a household; and (iii) the ratio of the difference between two spouses' earnings to their combined earnings. The first approach is not a direct measure of spousal disparity because when two spouses' earnings are equal, the inequality is not zero. The second method's advantage is its easy comparison between two sexes' earnings, but female benefits from the inequality may cancel out those of males (Woolley & Marshall, 1994; Bertrand *et al.*, 2015).

This paper uses the last method to calculate income inequality. It directly measures the magnitude of inequality within the household. The spousal income inequality is calculated by the ratio of the difference between spousal incomes to the combination of their incomes. We do not use the numerator's absolute value as we are interested in the gender aspect of the inequality: the inequality may be considered a measurement of a woman's power in the household. Inequalities in the other three statuses are defined similarly. Utilizing data from the United States' Panel Study of Income Dynamics, we point out significant relationships between parent's and son's family for those inequalities. In contrast, those between parents and their daughter's family are insignificant. Estimating the inequality transmission of educational and work hours is consistent with those for wage and income. An explanation for the consistency is the high correlation between education, labor supply, and earnings: the higher degree an individual gets, the more money she will earn. Also, the more she works, the more she earns. The paper also emphasizes the relevance of transmission of preference and gender-role view in the study of household problems.

2. Intra-household inequality and intergenerational mobility

Household inequalities play a crucial role in theories of intra-household resource allocation, social income distribution, as well as intergenerational persistence. Neglecting intra-household inequality may cause a serious understatement of social inequality and poverty estimation (Haddad & Kanbur, 1990). Woolley & Marshall (1994) argued that a measurement of intra-household inequalities is compelling because: (i) It is ubiquitous in both developed and developing nations; (ii) Many policy issues related to this kind of inequality. For example, an estimation of an individual's demands on household products and leisure

should be usually based on an assumption of a rule governing the sharing of household resources; and (iii) It may also influence tax policy. For instance, the US taxes the combined incomes of married couples while many other countries calculate income tax based on individual incomes. Improved information about intra-household inequality could help policymakers to design a better income tax system. Sociologists are interested in intra-household inequalities as they are important determinants of the division of power within families and causes of troubles and family dissolutions and can help explain gender-roles and gender inequality.

This study analyzes the extent of the intergenerational transmission of earnings, labor supply, and educational inequalities within households. One remarkable phenomenon in many western countries recently is the surge in the number of families where the wives out-earn their husbands. In the US, this kind of family is supposed to be less happy, suffer greater strife, and be more prone to divorce. The spousal inequality of earnings is also linked to domestic violence and marital instability (Aizer, 2010; Browning & Gortz, 2012; Zhang *et al.*; 2015; Bertrand *et al.*, 2015*).* Winkler (1998) highlighted the idea that the distribution of earnings between spouses may affect household decisions as well as labor market decisions. Theoretical works on bargaining within marriage (e.g., Lundberg & Pollack, 1996; Bergstrom, 1996) emphasized that the wives' relative earnings affect the "threat point"- the level of utility the spouses attain if the marriage dissolves - and their bargaining power in the household. The spousal educational differential is also a measure of their relative empowerment. A higher educational level provides women more opportunities to exit the marriage and still survive.

Concerning labor market participation, Chiappori (1992) argued that spousal labor supply partly reflects spouses' leisure time. The sharing rule of leisure time can be used as a proxy for the division of consumption between spouses. Spousal labor supply can be a proxy for their decision-making power. More participation in the labor market raises their likelihood of self-financing and having a good life when they leave the household (Jensen, 2012). Bargaining power may also affect other family members' working behaviors (Nguyen, 2019). From another perspective, Pollak (2005) suggested that spousal earnings affect their bargaining power, not the wage. As work hours determine the earnings, they also affect the power. Nevertheless, higher earnings, thanks to longer hours worked and less time for housework, do not create more power. But higher earnings thanks to high wage rates do. Moeeni (2019) focused on the interaction between education, wage, and labor supply. She argued that higher educational attainment leads to higher potential wages and improves the likelihood of labor force participation. On the other hand, spouses' educational attainment affects their negotiation power as well. Past literature also suggested alternative spousal bargaining power measures such as leisure time, housework, assets, and social status (Beegle *et al.*, 2001; Gupta & Stratton, 2010).

Regarding children's outcomes, previous literature supposed that women's empowerment is related to positive outcomes of their children as they are more

likely to invest in children's nutrition, food, education, and clothing. As primary childcare givers, their empowerment positively affects children's health and development as well (Thomas, 1990; Hoddinott & Haddad, 1995; Quisumbing *et al.*, 2003; Behrman & Hoddinott, 2005; Bobonis, 2009).

Transmission of social norms such as gender-role attitude helps explain the intergenerational transmission of the inequalities. Though there is no work directly dealing with the persistence of the disparities, past literature well documented the link in working behaviors across generations using data from various countries (Bütikofer, 2013). Following Fernandez *et al.* (2004), a series of studies found the connection in working status between mothers-in-law and daughters-in-law. As working mothers play a role model to sons in childhood, the sons' preference toward working women is well established and significantly affects their choice of a future wife. Kawaguchi & Miyazaki (2009) explored a similar topic using Japanese data. Although they did not find a clear relationship in full-time work status between mother and son's wife, they stressed that the son of a working mother does not favor traditional gender-roles.

While an extensive body of literature focused on the role of personal and work characteristics on gender inequality of economic status, few studies scrutinized spousal disparities in status. Non-unitary models considered spousal labor supply as an outcome of spouses' negotiations rather than being determined before the marriage (Kalugina *et al.*, 2009). Some studies confirmed that men's work hours are positively affected by educational attainment, work experience, and tenure but negatively affected by the number of children (Glauber & Gozjolko, 2011). A reduction in the female labor supply due to childbirth seriously influences their earnings (Winslow-Bowe, 2009). Literature also documented the effects of family income, spousal educational gap, race, and conditions shaping spouses' choices, especially those involved in labor division in the household, on the spousal wage gap. It highlights work conditions such as industrial, occupational, workplace discrimination, and household services in eliminating the disparity (Huato & Zeno, 2009). As income is the product of wages and work hours, it may be also determined by the negotiations and individual decisions rather than established before family formation.

Two theories can explain the contribution of relative spousal earnings: (i) gender specialization and (ii) economic independence. The first theory insists that spouses specialize in tasks based on gender to maximize total marital gains. An increase in male earnings reduces their wives' likelihood of joining the labor market since men specializing in the labor market and women specializing in housework make their marriage more efficient. For example, in one-income families, the wife usually is responsible for childcare and housework, while her husband works to earn money. The second theory suggests that both spouses compete to enhance their decision-making power in the family. Higher wives' earnings result in better bargaining power and improves their exit option from marriage. The theory argues that female labor force involvement is determined mainly by their education and work experience. The number of children is a key support to the specialization theory. Married men usually work more to compensate

for the decline of their wives' work hours following childbirth (Nguyen, 2013; Kulkarni, 2015). Other theories suggest that gender norms encourage men to be breadwinners and raise their labor supply availability after being a father. Fathers are also considered better than men without children in terms of commitment, productivity, and responsibility. They are usually offered higher salaries, more overtime work, and more promotion opportunities than their childless counterparts (Glauber & Gozjolko, 2011). Past literature also stressed the role of one spouse's labor supply as insurance against the other spouse's job loss. They documented a surge in non-work spouses' participation in the labor market and the labor supply of currently-participating spouses following their partner's unemployment (Stephens, 2002). Marriage market conditions and marriage laws may affect spousal labor supply by changing the resource allocation between spouses as well (Donni & Ponthieux, 2011; Nguyen *et al.*, 2018). Therefore, the transmission of spousal inequalities can be the consequence of transmission in behavior rather than matching two people with individual characteristics.

3. Literature review

A significant source of empirical literature for our study is those papers dealing with intergenerational mobility. Intergenerational mobility is determined as alterations in socioeconomic status from the parents' to their children's generation. The economic literature usually explores issues on the mobility of well-being (income, earnings, wages, consumption, savings, nutrition, health, etc.), human capital, and labor supply, while sociologists are interested in family and social issues (marital status, marital shocks, children's talents, context, and family culture, etc.). The theoretical literature on parental impact on children is often inspired by the influential works of Becker & Tomes (1979, 1986). Becker and Tome assumed that each family maximizes a utility function over their own and their offspring's generations. The endowment from genes such as race, ability, family reputation, or connections contributes to the outcomes of children when they become adults. Addio (2007) noted that intergenerational mobility gets the attention of social scientists because (i) the allocation of resources across generations influences the overall social welfare of those generations, (ii) mobility supports economic equality, social justice, and equity of allocation of resources, and (iii) mobility helps to attain better economic efficiency. As for Mogstad (2017), three essential ingredients for estimating intergenerational persistence include time in early life, a set of skills, and some types of investments.

An extensive body of previous literature dealt with intergenerational mobility of earnings. For the US, economists usually utilize the Panel Study of Income Dynamics data because it allows them to measure changes in parents' and children's status over time. Solon (1992) showed the biases in estimating intergenerational elasticity due to using short-run incomes or homogeneous samples rather than permanent incomes and random samples. His analyses provided an intergenerational correlation in long-run income for the US of around

0.4. Couch & Dunn (1997) and Osterbacka (2001), estimating for Germany and Finland, respectively, both found an elasticity of 0.1. Francesconi & Ermisch (2002) used the Goldthorpe-Hope score as a status measurement and found a correlation between 0.17 and 0.23 for Britain. Bjorklund *et al.* (2006) used Swedish data to quantify the persistence in income and schooling. They insisted that both pre and post-natal characteristics, such as the childhood environment, affect children's outcomes. Chetty *et al.* (2014) agreed with Lee & Solon (2009) that intergenerational mobility of income has remained stable over the last decades of the 20th century in the US. Concerning hourly wages, Altonji & Dunn (2000) used the US data to point out a similarity in wages between parents and children. Liu & Zeng (2009) insisted on the crucial role of the biological link between parents and children in intergenerational mobility in the US by likewise utilizing the Panel Study of Income Dynamics data. Recently, Neidhöfer *et al.* (2018) investigated 18 Latin American countries' household data and pointed out that intergenerational income mobility surges in this area. Corak (2020) used the Census data in 1986 to indicate that Canada's regional income mobility is determined mostly by the inequality among low-income families. Deutscher & Mazumder (2020), based on Australian administrative data to compare the intergenerational mobility of different regions, concluded that segregation and education are key determinants of mobility.

The second branch of literature is on educational mobility. Educational attainment is considered as more easily calculated than another economic status such as income. Notably, it is a crucial determinant for occupation choice and earnings (Stuhler, 2018). Overall, past literature suggested that the transmission of the attainment and qualifications are significant (Addio, 2007). Using German data on immigration, Frick & Wagner (2000) and Dustmann (2005) provided opposite findings on educational outcome links between two generations. The first confirms a clear link, while the second denies it. Some others investigating the US data, such as Card (2005) and Borjas (2006), tried to compare the persistence of the outcomes between native and immigrant groups and among different ethnic groups. Researchers also focused on the role of genetic inheritance and family characteristics on the transmission (Addio, 2007). For example, Huang (2013) used the US data to quantify the role of household assets on the transmission of educational attainment across generations. He found that assets improve the transmission of years of schooling. Recently, Agüero & Ramachandran (2018) evaluated the impact of educational reforms in 1980 on the transmission of schooling in Zimbabwe and pointed out a significant correlation between parents' and their children's secondary school attainment.

Our study also benefits from studies on the transmission of labor supply. Couch & Dunn (1997) discovered that the connection between fathers and sons in terms of work hours in the US is more robust than in Germany. Del Boca *et al.* (2000) investigated Italian data and detected connections between the labor market involvement of daughters and that of their mother and mother-in-law. Exploring the Survey of Income and Program Participation's data, Morrill and Morrill (2013) suggested robust links between the labor market involvements

of mothers and daughters, and mothers-in-law and daughters-in-law in the US. Notably, they acknowledged that the connection between mother-in-law and daughter-in-law is stronger. Van Putten *et al.* (2008) probed data of the Netherlands and indicated that daughters of working women have longer work duration than those of homemaking mothers. However, the labor force participation status of mothers does not affect that of their daughters. Altonji & Dunn (2012) analyzed the US data of National Longitudinal Surveys of Labor Market Experience and discovered a strong link in the work hours of same-sex family members. The association of weeks worked between same-sex parent and child is also uncovered. Using the March Current Population Survey, Blau *et al.* (2013) also found a correlation in labor supply between US-born women and their immigrant parents. The labor supply of women with foreign-born mothers is affected more strongly than with foreign-born fathers. They supposed that the reason for this phenomenon is the transmission of gender-roles across generations. Studies on the relationship between labor regulations and labor supply bring us useful arguments as well (e.g., Oreffice, 2007; Nguyen *et al.*, 2021a; Nguyen *et al.*, 2021b).

The literature on the in-law relationship also provided us some crucial insights. Fernandez *et al.* (2004), a notable study on this category, pointed out a strong correlation in weeks worked between mother-in-law and daughter-in-law using US data. Based on the work of Fernandez *et al.*, several other works investigated similar problems in different countries. Kawaguchi·& Miyazaki (2009) and Bütikofer (2013) utilized Japanese and Swiss data to revisit Fernandez *et al.*'s problem and ended up with the same conclusion. Kawaguchi·& Miyazaki explained that sons of working women prefer working wives to traditional wives. Papapetrou & Tsalaporta (2018) suggested that in Greece, a wife's labor market participation is impacted by both her mother's and mother-in-law's participation. Li & Liu (2019) tested the correlation between daughter-in-law and mother-in-law by son's gender-role attitude and household productivity based on Chinese data. Campos-Vazquez *et al.* (2014), using the Mexican context, insisted that the correlation is mainly fostered by sons with low educational levels. However, they did not find any link between a mother and her daughter in the labor market participation. Kailaheimo-Lönnqvist *et al.* (2019) examined a different problem: the impact of parents-in-law's resources on women's success in their career. They found that the resources improved the woman's occupational attainment in Finland.

Another branch of literature related to our work is on intra-household inequalities. It covers the disparities in earnings, work hours, education, and time allocation between husband and wife and the factors affecting them. Fuchs (1986) suggested using the ratio of average female earnings to average male earnings in a household as an index for earnings inequality. Figari *et al.* (2007) estimated the effects of public policies on marital income inequality through income and consumption. They supposed that public policies indirectly affect other kinds of inequalities, such as time-use inequality. To calculate spousal inequality, Woolley & Marshall (1994) and Kanbur & Haddad (1994) proposed an income inequality

index as (S1-S2)/(S1+S2), where S1 and S2 are the income of the better off and the worse off spouses, respectively. Bertrand *et al.* (2015) supported a traditional way of calculating wives' relative income: S1/(S1 + S2), where S1 and S2 are the income of a married woman and her husband, respectively.

The last important branch of literature for our reference is on assortative mating. Lam & Shoeni (1993, 1994) provided a model of the relationship between marital sorting and intergenerational transmission of schooling and earnings. Empirically, they found a more considerable impact created by the father-in-law's education than that of fathers on their children's outcomes in Brazil, while a reverse result is found in the US. They explained Brazil's findings as evidence of unobservable worker attributes rather than ones due to nepotistic family connections. Chadwick & Solon (2002) indicated that assortative mating in earnings could partly explain the process of intergenerational income transmission. Within the adult children's family, the man's earnings are just as elastic as those of his wife to the parents' earnings. Besides, Fernández *et al.* (2005) provided a model linking assortative mating, wage inequality, income, and economic growth. Ermisch *et al.* (2006) argued that how much income transmits across generations depends on both spouses' income. Both parents and parents-in-law affect their offspring's outcomes. They estimated the proportion of the covariance between parents' and their child's family income contributed by the parental generation's assortative mating. Recently, Mare (2016) observed a trend in educational assortative mating for decades in the US and found a fall in spousal similarity on educational attainment over time. Mare also documented a correlation in educational homogamy between two generations. As he explained, parents socialize their children to mate with someone like themselves. Greenwood *et al.* (2014) pointed out a rise in positive assortative mating in educational attainment between 1960 and 2005 in the US. However, the rise caused minimal influence on household income inequality. Siow (2015) also confirmed a surge in educational homogamy during the period 1970-2000 in the US. Eika *et al.* (2019) estimated the degree and evolution of educational marital sorting in some European countries and the US. They discovered a special connection between marital sorting and household income inequality in each country, as well.

4. Empirical model

Previous literature suggests that parents are role models for their children concerning household inequality. Our identification strategy provides evidence for this statement in terms of income, hourly wage, hours worked, and educational gaps between two spouses. We investigated the relationship between parents' inequality and their child's family inequality. As mentioned in the first section, this paper uses the ratio of the difference between spousal economic statuses to their combined statuses to measure the inequalities.

4.1. Economic status inequality

Our study evaluated the relationship between parents and their child's family in economic status inequalities (hourly wage, income, work hours, and education). We focused firstly on labor income. Considering a couple and their parents (either the husband's parents or the wife's parents), let Y_{Hi}, Y_{Wi}, Y_{Fi}, Y_{Mi} denote labor incomes of a man, his wife, his/her father and mother in the family i respectively. In a son's family, Y_{Hi} and Y_{wi} are defined as the son and his wife's incomes. In a daughter's family, Y_{Hi} and Y_{wi} represent the incomes of the daughter's husband and herself. Put differently; there are two types of relationship: (i) Parents and their adult son's family (i.e., their incomes are Y_F (father), Y_M (mother), Y_H (son), and Y_W (daughter-in-law)); and (ii) Parents and their adult daughter's family (i.e., their incomes are Y_F (father), Y_M (mother), Y_H (son-in-law), and Y_W (daughter)).

The study used the following formula, basing on Woolley and Marshall (1994) and Bertrand *et al.* (2015):

Child's couple income inequality: $$I_i^C = \frac{Y_{Wi} - Y_{Hi}}{Y_{Wi} + Y_{Hi}}$$

Parental income inequality: $$I_i^P = \frac{Y_{Mi} - Y_{Fi}}{Y_{Mi} + Y_{Fi}}$$

We did not use the numerator's absolute value because we are interested in the gender aspect of inequality and its transmission across generations. Winkler (1998) and Lundberg & Pollack (1996) suggested that earnings distribution between spouses may affect household decisions, labor market decisions, and spousal bargaining powers. Therefore, the above inequality definition can be understood as a measurement of female power in the family. The income inequality transmission equation is determined by:

$$I_i^C = \beta I_i^P + \varepsilon_i^I, \text{ namely,}$$
$$\frac{Y_{Wi} - Y_{Hi}}{Y_{Wi} + Y_{Hi}} = \beta\left(\frac{Y_{Mi} - Y_{Fi}}{Y_{Mi} + Y_{Fi}}\right) + \varepsilon_i^I \quad (1)$$

where ε_i^I is the set of unobservable characteristics in family i. For example, ε_i^I includes social norms and ability. The correlation between these inequalities is given by:

$$\rho(I_i^C, I_i^P) = \frac{Cov(I_i^C, I_i^P)}{\sigma(I_i^C)\sigma(I_i^P)} = \beta\frac{\sigma(I_i^P)}{\sigma(I_i^C)} \quad (2)$$

where $\sigma(I_i^C)$ and $\sigma(I_i^P)$ are the standard deviations of the inequalities. This implies that if the variance of inequality is unchanged over generations, the correlation between the two inequalities is the same as the transmission elasticity β.

If the permanent incomes are not available so that the inequalities have to be based on short-term incomes, a bias problem may arise (a problem similar to that mentioned in the seminal works Solon (1992) and Lee & Solon (2009)). To address this problem, Lee and Solon suggested using the average of incomes during a given period or an instrument variable, e.g., educational attainment, as a proxy for their permanent income. This paper used the first method; namely, the average incomes replaced for these permanent values. The empirical models for income and wage now become:

$$\frac{\overline{Y_{Wi}} - \overline{Y_{Hi}}}{\overline{Y_{Wi}} + \overline{Y_{Hi}}} = \beta\left(\frac{\overline{Y_{Mi}} - \overline{Y_{Fi}}}{\overline{Y_{Mi}} + \overline{Y_{Fi}}}\right) + \gamma X_i^I + \varepsilon_i^I \tag{3}$$

where $\overline{Y_{Zi}}$ denotes the average value of variable Y_{Zi} for n years in the long-term estimation, (Z = H, W, F or M). X_i^I includes personal and work characteristics. Concretely, we use the following formulas: $\overline{Y_{Zi}} = \frac{1}{n}\sum_{k=1}^{n} Y_{Zi}^k$, where Y_{Zi}^k denotes the value of Y_{Zi} in year k. The equations for transmission of wage, hours worked, and educational inequalities can be designed similarly.

4.2. Human capital difference

We were also interested in the transmission of the difference in two spouses' educational attainment as it is useful to investigate assortative mating. When the outcome belongs to a discrete set whose elements have intrinsic meaning (e.g., years of schooling), we can still use OLS to estimate the coefficient. However, when they have non-intrinsic meaning (e.g., overall health status: excellent, good, fair, poor), an OLS regression may be inappropriate. It is better to use an ordered-probit estimation. The equation for intergenerational transmission of educational difference is given by:

$$E_{Wi} - E_{Hi} = \beta(E_{Mi} - E_{Fi}) + \varepsilon_i \tag{4}$$

where E_{Hi}, E_{Wi}, E_{Fi}, E_{Mi} are years of schooling of husband, wife, father, and mother in the family i, respectively.

In addition, we proposed an ordered-probit model. In this model, both the dependent and explanatory variables (i.e., the child's family educational pattern and the parents' educational pattern) have non-intrinsic meaning. We considered three patterns: the man is more educated than his wife (hypergamy), the man is equally educated as his wife (homogamy), and the man is less educated than his wife (hypogamy).

A standard ordered-probit model is as follows:

$$\hat{D} = \beta X + \varepsilon \text{ with } \varepsilon \sim N(0,\sigma^2) \tag{5}$$

where $\hat{D}$ denotes the unobserved dependent variable and X denotes the explanatory variables. (In this equation, there is only one variable: parental family's educational pattern). β is a set of coefficients; ε denotes the error term. The distribution of $\hat{D}$ is therefore also normal: $\hat{D} \mid X \sim N(\beta X,\sigma^2)$. We cannot observe $\hat{D}$, but only observe D (child's family educational pattern). In the following equation, $\alpha 1$, $\alpha 2 \ldots$ αj are parameters to be estimated with β.

$$D = \begin{cases} 1 & (\textit{educ level of husband} > \textit{educ level of wife}) \textit{ if } \hat{D} \le \alpha_1 \\ 2 & (\textit{educ level of husband} = \textit{educ level of wife}) \textit{ if } \alpha_1 < \hat{D} \le \alpha_2 \\ 3 & (\textit{educ level of husband} < \textit{educ level of wife}) \textit{ if } \alpha_2 < \hat{D} \end{cases} \tag{6}$$

5. Main findings

5.1. Inequalities of labor market outcomes

The Panel Study of Income Dynamics (PSID) is our principal source of data. This is a longitudinal database of families and their members, starting in 1968. It is representative of the US population. PSID is one of the two most commonly used datasets in the US for studying intergenerational mobility. (The other is the National Longitudinal Survey of Youth). It has collected data annually since 1968 and biannually since 1997. As of 2017, the dataset included more than 80,000 individuals from around 11,000 families with seven generations. PSID collected self-reported information on the life course of multiple generations of the same family. The principal data is organized into five data files: family, cross-year individual, birth history, marriage history, and parent identification. Information collected covers family demographics, employment, income, consumption, education, health, housework, childbearing and development, and many other topics (PSID, 2020).

PSID allows us to extract information on the labor income of all four people (father, mother, child, and his/her spouse). We use the parents' data over the waves 1982-1994. The children's family data over the period 2005 - 2017 play the role of dependent variables. The 2017 sample is the most recent sample published by the PSID group when we conducted this study. As monetary values are expressed in current dollar prices, we use the Consumer Price Index measurement of the Bureau of Labor Statistics to standardize all the figures into 2017 dollars. Our analysis considered only adult children who are the family head or head's spouse. Both biological and adopted parents were used as PSID's structure allows us to

identify both types of parents. Children's family and their parents were selected as follows: first, we choose the period 2015-2017 for children's families and the period 1992-1994 for their parents. The average income of each spouse in the child couple was calculated over the first period, while each parent's income was calculated over the second period. Then, we considered the periods 2013-2015 and 1990-1992 for children's families and their parents respectively but ruled out those children, who were already included in the sample, to avoid duplication. The inclusion was repeated until the last periods (2005-2007 and 1982-1984 for two generations). Other dependent variables (hourly wage, work hours, educational attainment) were computed similarly. Importantly, all four people had to be between 30 and 60 years old to be included in the sample. The lowest age was 30 to ensure that their educational attainment was stable, while 60 was the prime age ceiling. All of them had marital status being married at the time used for the calculations.

Table 1 summarizes statistics on the primary sample. The variable description is in the Appendix. The sample consists of 2480 adult children, of which 48.31% were men and 51.69% were women. The average ages of husbands and wives were 43.7 and 42, respectively. Women got a little more education than men (14.47 compared to 14.09 years of schooling). However, men earned nearly double women. Men also worked around 1.5 times more than women. The average number of children was 1.95, i.e., remarkably lower than that of their parents' generation (2.36). 29% of heads of adult children's household had less than 01 years of work experience with their current organization, while 34% had more than ten years of experience. Each child couple had 1.67 workweeks missed annually due to illness of family members (including both self-illness and other-illness). Compared to their parents, child couples in the sample were younger but more educated, worked harder, and earned somewhat more.

We estimated the elasticities of transmission of household inequalities across generations based on the equation (3). Like traditional literature in intergenerational mobility, we first considered the case that exogenous variables were not included in the regressions. In this case, the estimations were significant in terms of income and hourly wage and marginally significant in terms of work duration and education for the pairs of parents and their son's family. The elasticities were 0.057, 0.061, 0.049, and 0.029 for income, hourly wage, hours worked, and years of schooling, respectively. However, the estimations for the pairs of parents and their daughter's family were insignificant.

Table 2 reports the transmission elasticities with the full set of exogenous variables. Panel A and B present results for income and hourly wage, respectively. The coefficients of interest were those of parental income and parental hourly wage inequalities. All columns were controlled for the number of children, number of children squared, number of siblings, number of opposite-sex siblings of the adult child, and variables involving the head of household, including dummies for national origin, Catholic preference, black status, job tenure, and farming sector (i.e., farming, fishery, and forestry sector), and number of weeks worked miss (i.e. weeks miss of both spouses), spousal age difference, and a

TABLE 1
STATISTIC SUMMARY

Child's family	Mean	Std. dev.	Min	Max
Husband's age	43.74	8.34	30	60
Wife's age	42.13	8.15	30	60
Husband's educational level	14.09	2.20	0	17
Wife's educational level	14.47	2.12	5	17
Husband's work hours	2083	832	0	5824
Wife's work hours	1443	939	0	5200
Husband's labor income	73707	93885	0	2120000
Wife's labor income	38323	44637	0	700000
Husband's hourly wage	35.65	114.0	0	5333
Wife's hourly wage	21.22	22.57	0	316
Control variables				
Number of children	1.95	1.31	0	11
Number of sibling	2.36	1.77	0	12
National origin (D)	0.60	0.48	0	1
Catholic preference (D)	0.18	0.39	0	1
Black (D)	0.17	0.38	0	1
Job tenure				
Less than one year (D)	*0.29*	*0.45*	*0*	*1*
From 1 to 5 years (D)	*0.19*	*0.39*	*0*	*1*
From 5 to 10 years (D)	*0.16*	*0.37*	*0*	*1*
10 years or longer (D)	*0.34*	*0.47*	*0*	*1*
Farming, fishing, and forestry sector (D)	*0.007*	*0.08*	*0*	*1*
Total weeks missed of both spouses	1.67	4.23	0	72.4

Parent's family	Mean	Std. dev.	Min	Max
Father's age	47.42	8.46	30	60
Mother's age	44.75	8.17	30	60
Father's educational level	12.92	2.78	0	17
Mother's educational level	12.68	2.28	0	17
Father's work hours	2067	843	0	5616
Mother's work hours	1179	915	0	5640
Father's labor income	65433	88997	0	1369480
Mother's labor income	22395	25122	0	307516
Father's hourly wage	29.84	36.73	0	491
Mother's hourly wage	16.56	41.37	0	932

Source: Calculated by the author.

log of taxable family income. Six regional dummies and time (year) dummies were also included in the regressions. The results revealed that only son families replicated their parental inequality concerning labor earnings and wage. The number of offspring, Catholic preference, and black status were determinants for child family inequalities. Working in the farming sector remarkably affected income inequality but nearly significantly impacted hourly wage inequality.

TABLE 2
TRANSMISSION OF INCOME AND HOURLY WAGE INEQUALITIES

A. DEPENDENT VARIABLE: CHILD'S FAMILY INCOME INEQUALITY
B. DEPENDENT VARIABLE: CHILD'S FAMILY HOURLY WAGE INEQUALITY

A.	*Child family's income inequality*		
	Child's family (both)	Son's family	Daughter's family
Parental income inequality	0.034*	0.075***	0.0001
	(0.020)	(0.028)	(0.028)
No. children	–0.096***	–0.121***	–0.087***
	(0.019)	(0.027)	(0.029)
No. children squared	0.010***	0.017***	0.007
	(0.004)	(0.005)	(0.006)
No. sibling	–0.016	–0.023	–0.012
	(0.010)	(0.014)	(0.014)
No. opposite-sex sibling	0.013	0.026	0.001
	(0.015)	(0.021)	(0.022)
National origin	–0.006	–0.036	0.021
	(0.024)	(0.034)	(0.035)
Catholic preference	0.044	0.089**	0.002
	(0.028)	(0.040)	(0.041)
Black	0.132***	0.100**	0.154***
	(0.033)	(0.045)	(0.048)
Job tenure:			
< 1 year	0.329**	0.280	0.364**
	(0.152)	(0.220)	(0.185)
1-5 years	–0.046	–0.143	0.045
	(0.151)	(0.216)	(0.183)
5-10 years	–0.071	–0.186	0.024
	(0.151)	(0.216)	(0.183)
>= 10 years	–0.151	–0.261	–0.062
	(0.150)	(0.217)	(0.181)
Farming sector	–0.237***	–0.341**	–0.167*
	(0.085)	(0.159)	(0.085)
Weeks of work missed	0.005	0.003	0.005
	(0.003)	(0.005)	(0.004)
Spouses' age difference	x	x	x
Log tax. income	x	x	x
Regional dummies	x	x	x
Time dummies	x	x	x
No. obs.	2307	1112	1195
R squared	0.14	0.17	0.13

B.	*Child family's hourly wage inequality*		
	Child's family (both)	Son's family	Daughter's family
Parental hourly wage inequality	0.028	0.076***	–0.009
	(0.020)	(0.028)	(0.028)
No. children	–0.077***	–0.097***	–0.067**
	(0.019)	(0.027)	(0.028)
No. children squared	0.008**	0.014***	0.005
	(0.004)	(0.005)	(0.006)
No. sibling	–0.014	–0.018	–0.014
	(0.010)	(0.014)	(0.014)
No. opposite-sex sibling	0.003	0.007	–0.001
	(0.015)	(0.020)	(0.021)
National origin	–0.009	–0.031	0.008
	(0.023)	(0.034)	(0.033)
Catholic preference	0.048*	0.089**	0.010
	(0.027)	(0.039)	(0.040)
Black	0.132***	0.107**	0.147***
	(0.032)	(0.045)	(0.047)
Job tenure:			
< 1 year	0.345***	0.146	0.432***
	(0.128)	(0.224)	(0.114)
1-5 years	0.032	–0.197	0.151
	(0.127)	(0.220)	(0.112)
5-10 years	0.007	–0.261	0.147
	(0.126)	(0.220)	(0.111)
>= 10 years	–0.085	–0.344	0.048
	(0.126)	(0.221)	(0.110)
Farming sector	–0.186***	–0.358	–0.064
	(0.119)	(0.222)	(0.112)
Weeks of work missed	0.009**	0.001	0.013***
	(0.004)	(0.006)	(0.003)
Spouses' age difference	x	x	x
Log tax. income	x	x	x
Regional dummies	x	x	x
Time dummies	x	x	x
No. obs.	2304	1110	1194
R squared	0.12	0.15	0.12

Source: Estimated by the author. 1st line: Elasticity. 2nd line, in parentheses: Standard error. Standard errors are clustered by personal identifiers.
*: Significant at P = 10%. **: at P = 5%. ***: at P = 1%.

In contrast, there is no evidence of the transmission of the inequalities to the daughter's family.

Table 3 was designed similarly to Table 2 but reports the transmission of work hours and educational inequalities. The coefficients of interest were those belonging to parental work hours and educational inequalities. All controlling variables were the same as those in Table 2. Again, we found that sons' families imitated their parental gap patterns but not daughters' families. Job tenure affected both inequalities, especially for those working for one year or longer. Meanwhile, Catholic preference and black status influenced the work duration inequality only. Notably, total weeks of work missed of both spouses due to illness of family members (including both self-illness and other-illness) were also a crucial determinant for the disparity.

Our findings are consistent with those of previous works. Bisin & Verdier (2001), for example, stated that parents pass on their preference to their offspring. Hellerstein & Morrill (2011) is among a few papers examining a fathers' role in their daughter's career selection. They found that the probability that women enter their father's occupation is significantly higher than other occupations for those born during the period 1909 and 1977. Powell & Steelman (1982) compared the impact of mothers' work behaviors on gender-roles attitudes of their sons and daughters. They stated that the effect is greater for sons than for daughters. Chadwick & Solon (2002) likewise indicated that the transmission of earnings across generations in the US is stronger for father-son pairs than father-daughter pairs. Fernández *et al.* (2004) more significantly pointed out the similarity in work status between mothers-in-law and their daughters-in-law as evidence for the transmission of gender-role attitudes from mothers to their sons. Also, sons of working mothers are a good partner for a working woman. That is, their household skills and cooperation in marriage are affected by their mothers. Works of other social sciences such as Kulik (2002) also indicated that correlation in gender-role attitudes between father and son is higher than that between father and daughter. Kulik explained this fact as the more liberal attitude of women and a more traditional attitude among men toward gender-role matters. An alternative interpretation for our results is that women may not wish to copy their mother's role within a household while men wish to replicate their father's role.

Some past literature also investigated the determinants of intra-household inequality. For instance, Winslow-Bowe (2009) used data from the US to show that wives' relative earnings are remarkably high among the black community compared to the white community. She interpreted this finding as a consequence of a greater labor supply of black women than their white counterparts and the disadvantage of minority men in the labor market. Huato & Zeno (2009) also examined the US data and documented that black husbands are linked with a notable lower level of intra-household income inequality. The presence of young children probably affected the spousal gap according to the model of gender specialization as it drives greater childcare, which is the mothers' responsibility and thus reduced their labor market involvement (Kulkarni, 2015).

TABLE 3
TRANSMISSION OF WORK HOURS AND EDUCATIONAL INEQUALITIES

C. Dependent variable: Child's family work hours inequality
D. Dependent variable: Child's family educational inequality

C.	*Child family's work hours inequality*			**D.**	*Child family's educational inequality*		
	Child's family (both)	Son's family	Daughter's family		Child's family (both)	Son's family	Daughter's family
Parental work hours inequality	0.030	0.054*	0.015	Parental educ. inequality	0.003	0.043*	–0.017
	(0.021)	(0.030)	(0.029)		(0.015)	(0.025)	(0.021)
No. children	–0.078***	–0.113***	–0.056*	No. children	–0.006**	–0.002	–0.012***
	(0.019)	(0.026)	(0.030)		(0.003)	(0.004)	(0.004)
No. children squared	0.007*	0.016***	0.002	No. children squared	0.0005	0.0004	0.001
	(0.004)	(0.005)	(0.006)		(0.0005)	(0.0007)	(0.0007)
No. sibling	–0.010	–0.019	0.0002	No. sibling	–0.003*	0.001	–0.007***
	(0.009)	(0.013)	(0.012)		(0.001)	(0.002)	(0.002)
No. opposite-sex sibling	0.014	0.033*	–0.007	No. opposite-sex sibling	0.0003	–0.002	0.003
	(0.013)	(0.019)	(0.018)		(0.002)	(0.003)	(0.003)
National origin	–0.003	0.013	–0.012	National origin	–0.004	–0.003	–0.004
	(0.021)	(0.030)	(0.030)		(0.004)	(0.004)	(0.005)
Catholic preference	0.032	0.062*	0.009	Catholic preference	–0.001	0.005	–0.007
	(0.024)	(0.033)	(0.035)		(0.004)	(0.005)	(0.006)
Black	0.091***	0.081*	0.100**	Black	0.014***	0.004	0.023***
	(0.030)	(0.043)	(0.042)		(0.005)	(0.007)	(0.007)
Job tenure:				Job tenure:			
< 1 year	–0.096	–0.165	–0.038	*< 1 year*	–0.025	–0.103	–0.002
	(0.107)	(0.202)	(0.135)		(0.018)	(0.068)	(0.012)
1-5 years	–0.327***	–0.399**	–0.256*	*1-5 years*	–0.036*	–0.113*	–0.013
	(0.106)	(0.202)	(0.133)		(0.019)	(0.068)	(0.012)
5-10 years	–0.311***	–0.354*	–0.266**	*5-10 years*	–0.035	–0.117*	–0.011
	(0.106)	(0.203)	(0.133)		(0.018)	(0.067)	(0.012)
>= 10 years	–0.363***	–0.422**	–0.313**	*>= 10 years*	–0.033	–0.113*	–0.009
	(0.105)	(0.202)	(0.132)		(0.018)	(0.068)	(0.011)
Farming sector	–0.116	–0.119	–0.125	Farming sector	0.016	0.018	0.021
	(0.098)	(0.192)	(0.096)		(0.012)	(0.016)	(0.016)
Weeks of work missed	0.009***	0.015***	0.006	Weeks of work missed	0.0005	–0.0005	0.001**
	(0.003)	(0.003)	(0.004)		(0.0004)	(0.0004)	(0.0004)
Spouses' age difference	x	x	x	Spouses' age difference	x	x	x
Log tax. income	x	x	x	Log tax. income	x	x	x
Regional dummies	x	x	x	Regional dummies	x	x	x
Time dummies	x	x	x	Time dummies	x	x	x
No. obs.	2353	1135	1218	No. obs.	2327	1122	1205
R squared	0.08	0.10	0.09	R squared	0.03	0.03	0.05

Source: Estimated by the author. 1st line: Elasticity. 2nd line, in parentheses: Standard error. Standard errors are clustered by personal identifiers.
*: Significant at P = 10%. **: at P = 5%. ***: at P = 1%.

5.2. Assortative mating

The transmission of educational difference can be a consequence of assortative mating and intergenerational educational attainment transmission. According to Lam and Shoeni (1993, 1994), the equations for the assortative mating of two generations are as follows:

$$E_{Wi} = \alpha_0 + \alpha_1 E_{Hi} + u_i \tag{7}$$

$$E_{Mi} = \gamma_0 + \gamma_1 E_{Fi} + \nu_i \tag{8}$$

where $E_{Hi,}$ $E_{Wi,}$ $E_{Fi,}$ E_{Mi} denote the educational attainment of a man, his wife, father, and mother in the family i respectively; $u_{i,}$ v_i denote error terms including unobservable factors relevant to mating in the family i. In empirical work, the equation (4) can be modified to include exogenous variables, X_i, such as household's specifics. We get:

$$E_{Wi} - E_{Hi} = \beta_1 (E_{Mi} - E_{Fi}) + \beta_2 X_i + \varepsilon_i \tag{9}$$

Assuming that the equation for educational transmission from a father to his son is given by:

$$E_{Hi} = \rho_1 E_{Fi} + \rho_2 X_i + \varsigma_i \tag{10}$$

In fact, we can combine the equations (7), (8), and (10) to get equation (9). Thus, the elasticity of educational inequality transmission depends on the elasticity of educational transmission and the assortative mating coefficients of the two generations.

5.3. Differential pattern of economic status

We investigated whether parents' educational gap affects their child's marital behavior in terms of the educational gap between the spouses. We are also interested in comparing the parents' educational pattern and that of their child's family.

The first panel of Table 4 classifies families into three family educational patterns for both children and parental generations: (i) the man is more educated than his wife, (ii) the man is equally educated as his wife, and (iii) the man is less educated than his wife. The next three panels are designed similarly but using income, wage, and work hours instead of education to calculate the differential patterns. The table indicates that the educational pattern changed remarkably between two generations. In the parents' generation, there were only 27.9% of families being hypogamous while this number in their child generation was nearly 41%. The shares of hypergamous families of the first

TABLE 4
PERCENTAGE OF GENERATIONAL FAMILY PATTERNS

Educational patterns			
Child family's educational pattern		Parental family's educational pattern	
Husband's education > wife's educ.:	25.14%	Father's education > mother's educ.:	37.31%
Husband's education = wife's educ.:	33.89%	Father's education = mother's educ.:	34.79%
Husband's education < wife's educ.:	40.96%	Father's education < mother's educ.:	27.90%
Work hours patterns			
Child family's work hours pattern		Parental family's work hours pattern	
Husband's hours > wife's hours:	69.76%	Father's hours > mother's hours:	77.42%
Husband's hours = wife's hours:	05.64%	Father's hours = mother's hours:	04.43%
Husband's hours < wife's hours:	24.60%	Father's hours < mother's hours:	18.15%
Income patterns			
Child family's income pattern		Parental family's income pattern	
Husband's income > wife's income:	68.39%	Father's income > mother's income:	77.14%
Husband's income = wife's income:	04.56%	Father's income = mother's income:	05.20%
Husband's income < wife's income:	27.05%	Father's income < mother's income:	17.66%
Hourly wage patterns			
Child family's hourly wage pattern		Parental family's hourly wage pattern	
Husband's wage > wife's wage:	63.51%	Father's wage > mother's wage:	71.49%
Husband's wage = wife's wage:	03.35%	Father's wage = mother's wage:	04.52%
Husband's wage < wife's wage:	33.14%	Father's wage < mother's wage:	23.99%

Source: Calculated by the author.

and second generations were 37.3% and 25.1%, respectively. Regarding earnings, the shares of income hypergamy were large for both generations, but that of the first generation were significantly greater than the second generation (77.1% and 68.4% for the first and the second generation, respectively). In contrast, the share of income hypogamy increased from parents' generation to their child generation. Similar phenomena happened for the hourly wage and labor supply.

Previous literature shed some light on our results. Analyzing micro-data of 120 countries in the world (including the US) for the period 1960-2011, Esteve *et al.* (2016) insisted on the termination of educational hypergamy and a surge in educational hypogamy. They found that wives of educational hypogamy families have a higher probability of being the breadwinners. Moreover, although motherhood prevents women from becoming breadwinners in the family, this fact may not be accurate for hypogamous couples. In the US, the contribution of married women's earnings to their family income slightly increased from 27% to 31% during the period 1970-1991. This augmentation occurred mostly in the decade 1980-1990. In general, the share of full-time working women in family income was greater (Hayghe, 1993). The attitude about the "marry-up" couple has also altered over time along with the change in gender disparity in education. The percentage of male college students who did not care about this increased remarkably from 41% to 60% between 1980 and 1990 in the US. The findings also indicated that wives' relative income or education might no longer significantly affect their marital stability (Esteve *et al.*, 2016).

On the other hand, Raley *et al.* (2006) showed a smaller share of earnings of hypogamy couples compared to that of educational hypogamy couples. They suggested that gendered norms on breadwinners have not altered as fast as educational opportunities. Using two waves 1996-1998 from the General Social Survey, they indicated that 40% of men and 35% of women still believed that it is better for both partners if the man specializes in the labor market and his wife specializes in housework. Winkler (1998) reminded us of assortative mating in education and earnings. She investigated the US' Current Population Survey data in 1993 and revealed that among 50% of dual-earner families, two spouses had the same educational level. And among 30% of these families, two spouses share the same quintile of earnings. She considered it as evidence of a correlation between education and earnings. Among the four economic statuses, the highest rate of resemblance is in education. It is probably because two partners meet in school. Winkler also noted that women are usually paid less than men even when they have the same qualifications. Therefore, it is not a surprise that the percentage of educational homogamy is much higher than that of homogamy in earnings. Juhn & Murphy (1997) supposed that women participate in the labor force because their work opportunities increase rather than a reduction of their husbands' opportunities. Moreover, as a consequence of the changing gender-roles between spouses in the family, the time used for housework of wives has fallen, though they still contribute substantially more time than their husbands in this work (Blau, 1998).

5.4. Transmission of educational patterns

Using the ordered-probit model, we can estimate the effect of the parents' pattern on their child's family pattern. Tables 5 and 6, based on equation (6), classify families into three educational patterns for both generations: (i) the man is more educated than his wife, (ii) the man is equally educated as his wife, and (iii) the man is less educated than his wife. The results show a significant connection between parents and their son's family. The effect of parents is more marked for "married up" son families than those for "married down" ones. A negative (-2.3%) marginal effect of parents on the probability of the son's family implies that an increase in the parental educational gap is connected with a decrease in the incidence of son families being of the "married down" type.

TABLE 5
ORDER PROBIT: TRANSMISSION OF FAMILY'S EDUCATIONAL PATTERN

	Child's family educational pattern								
	In child's family (both genders)			In son's family			In daughter's family		
	β	α1	α2	β	α1	α2	β	α1	α2
Parental family's educational pattern	0.028 (0.029)	–0.632 (0.038)	0.275 (0.037)	0.070* (0.042)	–0.522 (0.054)	0.413 (0.054)	–0.002 (0.041)	–0.729 (0.054)	0.158 (0.051)

TABLE 6
ORDER PROBIT: PROBABILITY AND MARGINAL EFFECTS

	Probability of son family's educational patterns		
	Husband's educ > wife's educ	Husband's educ = wife's educ	Husband's educ < wife's educ
Parental educational pattern:			
father > mother	30.1%	35.9%	34.0%
father = mother	27.7%	35.7%	36.6%
father < mother	25.4%	35.4%	39.2%
	Marginal effects on son family's educational pattern		
	Husband's educ > wife's educ.	Husband's educ = wife's educ.	Husband's educ < wife's educ.
Parental educational pattern	-0.023* (0.014)	-0.003 (0.002)	0.026* (0.016)

Source: Estimated by the author. 1st line: Elasticity. 2nd line, in parentheses: Standard error. *: Significant at P = 10%. **: at P = 5%. ***: at P=1%.

Mare (2016) documented a U-shaped curve in educational homogamy during the 20th century in the US. He also showed a notable transmission of homogamy across generations. An explanation for this fact is the socio-economic reproduction at the intra-household level. The transmission also contributed to the trend in spousal resemblance in educational attainment. Homogamy was found much more likely among people who went to the same or nearby university (Nielsen & Svarer, 2009). Gonalons-Pons & Schwartz (2017) investigated the US data for the period 1970-2013 and argued that an increase in earnings homogamy is mainly led by alternations in the allocation of labor market time rather than alternations in assortative mating on earnings. Andrade & Thomsen (2018) investigated Danish population data and insisted on a reduction in educational homogamy between 1984 and 2013. But the odds ratios of having educational resemblance among university graduate couples were still remarkable. Also, returns to education contributed very little in explaining the homogamy patterns of the period.

In summary, the empirical section showed a transmission from parents to sons' family in income, wage, work duration, and educational disparities. The findings are consistent with those of many past works in economics and other social sciences on the transmission of marital preference, gender-role attitude, and marital choices across generations (e.g., Bisin & Verdier, 2001; Charles & Hurst, 2003; Fernandez *et al.*, 2004; Farre & Vella, 2013). Some of the past works indicated that sons mimic their parents more than daughters regarding gender-role attitudes (Powell & Steelman, 1982; Kulik 2002) or earnings (Chadwick & Solon, 2002). This section also emphasized the role of marital sorting in the transmission of the disparities and explores the reproduction of educational patterns across generations.

6. Conclusion

The study provides the first evidence on the transmission of spousal inequalities across generations. It shows a similarity in inequalities of income, wage, work hours, and education between parents' and son's family but those between parents and daughter's family are insignificant. The study most relating ours is Fernandez *et al.* (2004). Fernandez *et al.* suggest that sons use their mother working behavior as a stereotype in selecting a marital partner. That causes evolution in men's attitudes toward women's work and changes their preference for their wives' working behavior. They explain that the transmission of preferences influences women's education and labor choices across generations. In this paper, we also see the link between parents and son's family in inequalities due to the transmission of preferences. The findings of our study may reflect the biological transmission and imitation of attitude among generations as well. Using PSID, we can benefit from the intergenerational and the panel structure. The disadvantages of PSID are the small sample size and the asymmetric structure of income data between a wife and a husband in the same family. Nonetheless, the research results contribute to the theories of intergenerational mobility, income distribution, and intra-household resource allocation.

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Appendix. Variables description

Husband (wife)'s age	Age of husband (wife) when included into the main sample
Husband (wife)'s education	1-16: the actual grade of school the husband (wife) completed, 17: completed at least some postgraduate work
Husband(wife)'s work hours	Total average annual hours worked of husband (wife)
Husband (wife)'s labor income	Husband (wife)'s average labor income, excluding farm and business income
Husband (wife)'s hourly wage	Husband (wife)'s average hourly wage
Number of children	Number of children of the adult child
Number of sibling	Number of sibling of the adult child
Number of opposite-sex sibling	Number of opposite-sex sibling of the adult child
National origin	Dummy variable, = 1 if head of the child household's ethnic group was National origin
Catholic preference	Dummy variable, = 1 if head of the child household's preference was Catholic
Black	Dummy variable, = 1 if head of the child household's race was black
Job tenure	
Less than one year (D)	Dummy variable, = 1 if head of the child household had less than 01 year of working experience with the current organization
From 1 to 5 years (D)	Dummy variable, = 1 if head of the child household had 01-05 years of working experience with the current organization
From 5 to 10 years (D)	Dummy variable, = 1 if head of the child household had 01-05 years of working experience with the current organization
10 years or longer (D)	Dummy variable, = 1 if head of the child household had at least 10 year of working experience with the current organization
Farming, fishing, and forestry sector (D)	Dummy variable, = 1 if occupational sector of head of the child household was farming, fishing or forestry
Weeks of work missed	Total weeks of work missed of both spouses due to illness of members in family
Taxable income	Total annual taxable income of the family
Father (mother)'s age	Age of father (mother) when included into the main sample
Father (mother)'s education	1-16: the actual grade of school father (mother) completed, 17: completed at least some postgraduate work
Father (mother)'s work hours	Total average annual hours working of father (mother)
Father(mother)'s labor income	Father (mother)'s average labor income, excluding farm and business income
Father (mother)'s hourly wage	Father (mother)'s average hourly wage

EU minimum wages: To what extent does ideology matter?*

Salarios mínimos de la UE: ¿Hasta qué punto importa la ideología?

Francisco J. Sánchez-Vellvé**
Manuel León Navarro***

Abstract

This paper estimates the importance of the political and ideological position of the ruling party in determining the minimum wage in the European Union Member States. To this end, a database that establishes the position of each government in each country and year is built. Using the panel data methodology, we conclude that the center-right governments tend to have lower relative minimum wages. The same result is found when the Chapel Hill Expert Survey policy indexes the are used. Ideology does not discriminate between conservative or liberal governments due to both of them setting minimum wages at similar levels, though lower than governments of social ideology.

Key words: *Politics, ideology, minimum wage, statutory wages.*

JEL Classification: *D78, E64, J38, J88, O52.*

Resumen

En este trabajo se estima la importancia de la posición política e ideológica del partido gobernante en la determinación del salario mínimo en los países de la Unión Europea. Para ello, se construye una base de datos que refleja la posición de cada gobierno en cada país y año. Utilizando la metodología de datos de panel, se concluye que los gobiernos de centro-derecha tienden a tener un salario mínimo inferior. El mismo resultado se encuentra si se utilizan los índices de política construidos por la Chapel Hill Expert Survey. La ideología no discrimina entre gobiernos conservadores o liberales, ya que ambos tienden

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a tener un salario mínimo similar aunque inferior a los gobiernos de ideología social.

Palabras clave: *Política, ideología, salario mínimo, salario legal.*

Clasificación JEL: *D78, E64, J38, J88, O52.*

1. Introduction

The level at which statutory minimum wages have to be set, or the suitability or not of raising them is one of the most discussed economic issues. The debate arises frequently in academia, in journalism, but also in the political arena. For instance, the rise in minimum wages proposed by US President Barack Obama in early 2014 led to many academic and popular articles being written, as many from those who are in favor as from those who are against such measures.

It is not uncommon that the rise of statutory minimum wages, which are established in many economies, is integrated into electoral programs of some political parties as an electoral "promise". As well, it is frequent to discuss the level of minimum wages in electoral debates between candidates from different parties. The positions of each other respond to largely ideological components, sometimes without any empirical support, but conditioned by the existence of this legal entity in many economies.

Consequently, it is not surprising at all to see how social-democratic or radical politicians defend raising minimum wages as a necessary step in the struggle against existing income inequalities in our societies. To the same extent, liberals[1] and conservatives tend to hold positions that, while not embracing in full the free labor market, are more prone to it.

For sure, both sides will have to manage a statutory minimum wages policy if they are elected to govern, and how to do so can be considered conditioned by ideological or political positions of political parties, essentially when it comes to European economies. Based on this hypothesis we wonder, to what extent does the ideology of ruling political parties in European Union determine decisions on statutory minimum wages?

It is important to find out the determinants of the minimum wage and to study the influence of politics and ideology, because if they are not significant and, on

[1] Since our work focuses on the member states of the European Union it is important to underline that liberalism has a different consideration in the different countries of the world; for while in the United States the political position that advocates a mixed economy, social justice, and approaches to socialist or leftist ideas is considered liberal; in Europe, those parties that focus their programs in defence of individual liberties and the non-intervention of the State in the economy as well as in the decisions of individuals are considered liberal (see appendix).

the contrary, the economic factors or the influence of lobbyists are the relevant determinants, political debate on the minimum wage will have no real content.

From an academic point of view, the majority of the literature on minimum wage setting focuses on explaining the effects that these may have on different economic variables. Thus, negative and positive effects on unemployment have been found (Brown *et al.* (1982), Stiglitz & López Casasnovas (1993), Card & Krueger (1995), Dolado *et al.* (1996), Neumark & Wascher (2000), Manning (2005), Stewart (2004), Portugal & Cardoso (2006), Dube, Lester, & Reich (2010), Burkhauser & Hansen (2012), Boeri & Van Ours (2013) Rivera (2013), Krugman, Graddy & Wells (2013), Hoffman (2015)). Furthermore, the effect of minimum wages on income distribution inequality has also been studied, and the conclusions are that a reduction in minimum wages would widen the wage dispersion among those who are working, increasing inequality (Dube *et al.* (2010), Neumark, Salas & Wascher (2014), Addison, Blackburn & Cotti (2015), Autor, Manning & Smith (2016)) and that specifically, paying attention to the gender perspective, the increase in the minimum wage leads to a decrease in the gender pay gap as a consequence of the over-representation of women among low-wage workers (Amadxarif *et al.*, 2020; Robinson, 2005; Blau, 2003).

Finally, the impact minimum wages have on poverty and collective welfare has been studied as well (Dube (2018), Card & Krueger (1995), Neumark & Wascher (2002; 2005; 2010)).

Nevertheless, the literature that studies the determinants of minimum wages is much less abundant than that dedicated to studying the effects of them. In addition to the effects of other economic variables that are used as control variables, the published works find out two fundamental factors that explain the differences in minimum wages: 1) The existence of interest groups, such as trade unions or representative employers' organizations; 2) The political position of the ruling party.

Among the former, Boeri (2012) shows the causal relationship between the minimum wage fixing system and the level of this, concluding that when the system is based on collective bargaining, statutory minimum wages are higher than when they are established by law. A positive effect of the quantity of unionized workers on the minimum wage is found in Silberman and Durden (1976), Bloch (1993) and Seltzer (1995) in the US labour market. Sobel (1999), also for the USA, discovers an effect not only on the trade unions but also of the employers' organizations.

Additionally, there are other works on the determinants in the exercise of political power such as those of Belcher M. (2010) or Pontusson et al (2002) that study how the institutional context, wage inequality and union density affect the decision-making process of voters in terms of mobilization and of the ruling party.

In the second group, much more focused on our subject of study, Wursten (2017) suggests that political determinants are the missing variable in the traditional employment/minimum wage regressions, suggesting that political orientation implies a set of policies which affect both the level of employment and the minimum wage. Kau and Rubin (1978), Besley and Case (1995), Levin

and Waldman (1998), Waltman and Pittman (2002), Green and Harrison (2006) and Ford, Minor and Owens (2012), find that politics plays an important role in determining the minimum wage in the United States. Xing and Xu (2016) also concluded the influence of certain political factors for the case of China. In Canada, Blais *et al.* (1989) and Dickson and Myatt (2002) found that the behavior of the relative minimum wage is much in line with that one of the real minumum wage, and also that the relative minimum wage is higher when the government is left-wing and tends to be lower when the government is right-wing or liberal, with no differences between the two of them.

However, as far as we know, there is no work that explains the determinants of minimum wages at EU level and therefore the aim of this article is to solve this scarcity. Thus, in this paper we research whether ideology or the political position of the ruling party have influence on the management of relative minimum wages and what is the sign of its relation in the EU area.

It is considered that using the EU area to explain the effects of politics on the minimum wage is particularly interesting because there is sufficient diversity of political positions, but with homogeneity among Member states, which allows control of the absence of other effects, such as monetary policy or migration restrictions between countries.

In the European Union, there is a great diversity in minimum wage fixing systems, but most of them are established by law. Only 11 out of the 28 Member States have a method of establishing minimum wages based on collective bargaining and there are four of them that maintain the possibility of the government fixing the universal wage in the event of failure to reach an agreement (Schulten, 2014); which means that practically they have a method of fixing very close to determining the national minimum wage by law. In this paper, the scope of analysis only takes into account the EU Member States that set the minimum wage by law, as it is in these countries that the influence of politics and ideology can be studied.

To carry out the objective of the work, we built a database where the political position and ideology of the ruling party is classified for each State and moment of time[2]. In a complementary way and to compare the results of our analysis, we use the database of the Chapel Hill Expert Survey (CHES) (Bakker, Edwards *et al.*, 2015) on political and/or economic ideology and the position of parties in the EU Member States.

In order to analyze the importance of the government's ideological component in setting the relative minimum wages, we estimate different regression models with panel data methodology. This estimating method helps us to reach conclusions based on a larger amount of data, with more degrees of freedom and getting more consistent results than those that would be provided with a

[2] The countries that we consider in our study are Spain, France, United Kingdom, Portugal, Slovenia, Greece, Ireland, Luxembourg, Netherlands, Poland, Czech Rep., Romania, Lithuania, Latvia, Bulgaria, Hungary, Malta, Belgium, Slovakia, Estonia, Croatia.

temporal or a cross-sectional analysis. Additionally, it allows the inclusion of the cross-section fixed effects for different countries in order to capture specific factors from Member States that influence the relative minimum wage levels.

The results, beyond the multiple economic and social factors studied in the empirical literature on the issue, highlight the importance of considering both the political position and the ideology of the ruling party as determinants of the management of relative minimum wages. Thus, according to estimates there is a negative effect on the relative minimum wage if the government is center-right. Regarding ideology, it is found that the minimum wage tends to be higher if the government has a social ideology. This result shows that minimum wages policy is partially determined by society and that, similarly to what Korpi (1985) suggests, wage-earners can change their situation through the choice of governments that advocate decisions that can influence the distribution of wages.

A similar result is found when the variable that measures political position is not qualitative. In this case, for each point that political position built from the CHES index increases or moves to the right, the relative minimum wage is reduced by 0.4%.

The rest of the paper is organized as follows. In section 2, the positioning of political parties regarding legal minimum wages is explained; also, the theoretical arguments are presented so that these minimum wage policies may not be implemented once the parties reach the government. In section 3, we explain the data and criteria used in building the database of the political and ideological component of ruling parties. In section 4, the empirical model and the econometric results are shown. Finally, in section 5, we display the main conclusions.

2. Political Parties: Position regarding minimum wage and causes of its possible non-application

Although political parties take clear positions in relation to various policies, they do not always carry them out once they reach the government. In this section the fundamentals of these positions on the minimum wage and the theoretical arguments that may explain its non-implementation once they become the ruling party are exposed.

The political position of the parties regarding statutory minimum wage is diverse and it is explained by the effects minimum wage has on other economic variables. Among the positive effects can be highlighted those on economic inequality, gender pay gap and poverty. Among the negative effects, the most important are the increase in unemployment or the increase in wage costs.

Thus, social parties usually propose the increase of the legal minimum wage, since they consider that the positive effects are greater than the possible negative effects, such as the increase over unemployment. On the contrary, liberal parties maintain that negative effects are preponderant and, therefore, are in favor of the market regulating wages. Finally, among the different conservative parties there is more dispersion regarding the policy on the minimum wage, although

in general, they do not propose reductions in the minimum wage and are not reluctant to modest increases.

As is known by all, political parties set out their approach to various economic and social issues in their founding statutes (manifestos), however in the literature we can find a wide range of theoretical causes that explain why an economic policy is not put into practice, both in government and opposition parties.

In this regard, the aim of maximizing the number of voters, the probability of winning or the expected plurality may lead political parties to set up policies that represent not so much their political ideology but the median voter ideology, which is optimal to win the elections.

Similarly, myopia of voters can have the same effect on effective politics. As a matter of principle, voters make their decisions based on past information, "retrospective voting", information on future policies, "prospective or strategic voting", information on their personal circumstances, "pocketbook voting" or the effects on the economy general "socitropic voting" (Van Winden, 1988). However, if voters do not consider the previous information when voting, political parties can alter their policies without expecting any effect on the electoral results.

In addition, Bawn et al (2012) propose a theory according to which voters can not be certain of policies prompted by politicians and, therefore, political parties can carry out policies other than those included in their programs without suffering any electoral cost ("electoral blind spot").

Another reason for the programmatic failure of ruling parties is explained by the role of bureaucrats. Nevertheless, the controversy of this cause is important as there are studies that focus on explaining the effects of bureaucrats on government decisions (Huber and Shipan, 2002, Gailmard and Patty, 2007), while others show evidences that public workers work according to the rules, based on their loyalty to the organization, to the public service and to the needs and interests of citizens (Pierre, 2017).

Another argument for political parties do not carry out certain policies is the role played by pressure groups. These groups try to influence politicians in one direction or another to achieve their interests. A theoretical paper of the role of these groups can be found in Potters and Van Winden (1996) and an empirical research can be found in Potters and Sloof (1996). In the case of the minimum wage, the role of trade unions is especially important, Boeri (2012).

Economic conditions can also alter the programmatic position of political parties and the economic policy to be promoted to influence the economic cycle and thereby influence the predisposition of citizens' votes (Haupt, 2010).

However, as explained above, there is a wide range of additional factors that can change the political position in parties' programs, both government and opposition (Fagerholm, 2016). In addition to those already mentioned, the most relevant ones are summarized below:

- The way in which political parties are internally organized can affect the actual policy they intend. That is, within political parties might be incentives not to perform, or to refine, the policy that party's ideology would set. In some

cases, it is the candidate of a party the one who takes position between the median of the party and that of the electorate, Aldrich (2011); in others, the adjustments respond to the balance of power between leaders and militants (Schumacher et al, 2013).

- The loss of votes can induce changes on the policy proposed by parties; In fact, political parties react to electoral results, especially if there has been an electoral defeat (Ezrow, 2011, Somer-Topcu and Williams, 2013).
- According to the "market party model" (Laver, 2005; Fowler and Laver, 2008) program shifts made by political rivals, are also the reason for changes of the political position of the parties.
- Ruling parties are more likely to shift their political position than opposition parties, since their change is more visible in society (Schumacher et al, 2013).
- Political parties react to changes in public opinion but only when the latter moves away from the party (Adams et al, 2004). Among the non-radical parties, the social-democratic parties react less than the center or right parties. (Adams and Somer-Topcu, 2009); Meanwhile, political parties with strong militants and relatively weak leaders (usually leftist parties) tend to respond to their militants and not so much to the median voter, who would represent public opinion (Schumacher et al, 2013).

In a way, it can be said that it is not certain that the minimum wage management carried out by the ruling parties will be the expected one accordingly to their ideology or political position, since we have verified that there are many studies that explain the changes in the political positions of the parties, both from the theoretical and empirical point of view.

3. Data and Information Sources

In order to carry out the analysis that we have proposed, a database has been built in which, for each year from 1990 to 2015, the dominant ideology and political position of the respective governments of the Member States is determined. The source used is the available information at www.parties-and-elections.eu (Nordsieck, 2015), which consists of a complete database of legislative elections in Europe since 1945 and provides a comprehensive information and data about political parties, elections and governments.

We are not going into the debate about what ideology is, which is beyond the scope we have proposed for this work. However, in order to give objective consistency to this article, we highlight that we share Baradat's (2015) view that ideology is a "political expression". Therefore, we understand that it is a synthetic way of summarizing the social, economic and political objectives that different political parties could have and how they intend to achieve them. In this way, political parties seek electors´ mobilization in Western democratic systems. A more detailed description of each ideology and its characteristics can be found in the appendix (table A1).

In general, the ideological self-definition of political parties and how they are grouped in the European Union provide an aprioristic idea of the political spectrum of the political parties that have assumed at some point the government of their country between 1990 and 2015 (see figure 1).

FIGURE 1
POLITICAL SPECTRUM OF RULING PARTIES IN THE EU 1990-2015

As can be observed, parties of practically the entire political spectrum have ruled, with the exception of parties of reactionary ideology, which are not contemplated in the previous figure. Following Baradat (2015), reactionary parties are understood as those who reject current institutions and the achievements of society, and consider more appropriate the policies of the times prior to those they propose to return. This type of party would be at the right end of the spectrum showed in Figure 1.

Positions on both the left and the right of the political spectrum are rooted on philosophical foundations, while the central positions could be described as moderate, albeit intending to tackle improvements and social changes gradually.

When it comes to ideology and position in the political spectrum, a certain caution must be observed because there are factors that could condition the possible classification of ruling parties in the spectrum and because of that the results of the analysis:

- First, ideological classification of a party is conditioned by the one who performs it. That is to say, it is conditioned by the position of parties in the mind of every citizen, and we are no exception to this rule.
- In addition, the evolution of history has led many political parties to be the result of coalitions of parties, usually close to each other ideologically speaking, to have the opportunity to reach the government.
- Finally, although ideology places parties within the political spectrum, this position evolves over time and is conditioned by the political, economic and social environment of society; so you cannot say categorically that one political party always maintains the same position.

We avoid these drawbacks by using the dominant ideology in the governments of each state, and considering as such the one that ruling parties or the prime minister party in the case of coalition define themselves. This means that we consider the ideology and position of the party of the prime minister or chancellor in most countries, but that of the president of the republic or president of the government in others. The choice depends on who holds the executive power,

because we are analyzing a set of countries that have democratic systems, but with different institutional organization and political power distribution. And given that our field of study is the European Union, the fundamental reference to decide who to consider is provided by who is representing the country in the maximum institutional bodies of the EU.

In the case of a ruling coalition that ran for elections, we take into account the position from the most important party in that coalition. If the coalition is subsequent to the electoral process, even when the decision-making of the government is the result of the agreement of the entire cabinet (Martin and Vangerg, 2014), the position of the prime minister's party is considered, in the same terms that we had indicated above.

Political position means the relative position of the ruling party on the left-to-right axis of political spectrum: left, center-left, center, center-right, right.

Ideology is understood as the preponderant ideological orientation in the political party of the prime minister, because sometimes the political inspiration is so broad that there may be some controversy in the standings. In our case we have used the following categories: Communist, Socialist, Social-Democrat, Social-Liberal, Demochristian, Liberal, Liberal-Conservative, Conservative, Nationalist and Independents. The annex provides a brief description of the characteristics of each of these classes.

From a methodological point of view, when a political party has disappeared, we assign to it the corresponding values of the party in which it or most of its leaders have been integrated.

In order to work with these variables in empirical analysis and to study the influence they can have on changes in relative minimum wages, two alternative groups on the political position have been used. The first alternative corresponds to the starting definition, where all variables are dichotomous qualitative variables that take the value 0 or 1, indicating respectively absence or presence of that political position in the ruling party. Meanwhile alternative 2 is the result of the breakdown of the political left and right into two groups respectively, one more centered and the other more radical.

TABLE 1
ALTERNATIVE GROUPS OF POLITICAL POSITIONS FOR RULING PARTIES

Group 1	**Group 2**
Left	Left Center Left
Center Right	Center Center Right Right

From the ideological position, three qualitative variables have also been generated, taking values 1 or 0 depending on whether or not the ideology of the

ruling political party is in that class. In this case, we have grouped the variables taking into account the ideological proximity and fundamental differences in terms of economic policy ideology as shown in table 2.

TABLE 2
VARIABLES OF POLITICAL IDEOLOGY OF RULING PARTIES

Variables	Classes
Social	Communist Socialist Social democrat
Liberal	Liberal Liberal-Conservative Socio-liberal
Other	Conservative Christian Democrat Nationalist Independentist

Because the above variables are not free from a certain subjective character, we have also worked with variables of political and economic position in the political spectrum from the five waves of Chapel Hill Expert Survey (CHES) (Bakker, De Vries *et al.*, 2015), which go from 1999 to 2014 and are the result of the judgment of experts who place the ideology of each party on a scale of 0 to 10, with 0 being the extreme left, 5 the center and 10 the far right. As the position of political parties may change over time, we use the register provided by CHES at each time point. When in some year there are no values for the ruling party, we take the nearest available register as proxy of the ideological score.

To study the behavior of minimum wages with respect to average wages in the different European economies we will use the Kaitz Index. This is a method of linking the absolute level of minimum wages to the general distribution of wages, since it relates minimum wages to central tendency measures (in our case the average). The data published by the OECD Labor Force Statistics and the Eurostat data for Bulgaria, Malta and Croatia are used as an indicator of relative minimum wages with respect to the average salary distribution of each EU Member State.

The use of this index helps to avoid problems of comparisons in absolute terms, which are conditioned by differences in purchasing power and productivity among different State Members.

Low levels of the index point to a noticeable gap between the minimum and average wages, which means that any variation of it may have a potentially low impact on the rest of the wages. However, if the index is high in relative terms, the impact of any variation in statutory minimum wages could be very

significant, since in this case the distributions of wages are less dispersed and, as a result of it, a larger number of workers could be affected.

There will be positive changes in relative minimum wages when statutory minimum wages grow more or decrease less than average wages and negative changes when statutory minimum wages increases are lower or the setbacks higher than those registered in the average wage.

Consequently, it can be concluded that changes in relative minimum wages will also be conditioned by its level. Changes will be less likely if they present high levels than if they present a relatively low ratio.

To test if lobbyists have influence in determining the minimum wage, we included the ratio of union membership obtained from ICTWSS[3] in the analysis.

Finally, the empirical study also considers some control variables used in the minimum wage literature. These variables allow the statistical control of the effects of the remaining variables. Thus, the unemployment and the participation rates, published by Eurostat (EU Labour Force Survey), are included. Increases in real output per person, the percentage of social benefits in GDP, inflation rate, the percentage of temporary employment and of part-time employment, all of them published by Eurostat, are also included.

Although the database is not complete, the above data are available from 1990 until 2013 for all EU countries that set minimum wages by law (Table A2).

4. Empirical model and econometric results

The estimation of the influence the political and ideological position of the EU governments has in determining the statutory minimum wage is carried out using the panel data methodology under the assumption of fixed effects. This methodology is suitable because the analysis includes all countries that determine the minimum wage by law.

When estimating with fixed effects, we avoid the econometric problems deriving from the social or economic differences among different Member States.

First, we consider a model in which there are no ideological or political variables to determine which economic variables are relevant when explaining the differences in relative minimum wages among countries. Next, we estimate the effects of politics and ideology.

The estimation process for all the considered models is the following: First, the model is estimated by the fixed effects method. Then, we run the contrast of Wooldrige (2002) to check the presence of residual autocorrelation. Once we confirm that the disturbances have good properties, an inference process is carried out, eliminating all non-significant variables one by one and re-estimating the model at each iteration. Ultimately, the final model is robustly estimated

[3] Database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts with data for 51 countries from 1960 to 2014

and, if there are no differences in the results, we conclude that the estimators are acceptable.

The variables that could explain the differences in the relative minimum wage (SMR) are: union affiliation ratio (AFS), unemployment rate (TDES), activity rate (TA), inflation (INFL), productivity increase (INCPROD),social benefits expenditure to GDP ratio (PRESTSOC), percentage of partial employment (PTFT) and percentage of temporary employment (EMPTEM).

Before estimating, it is convenient to contrast the stationarity of variables included in the analysis. Therefore, Table 3 presents the usual hypothesis contrasts in the panel data literature. These contrasts determine that PRESTSOC, PTFT and EMPTEM are I (1) and, in consequence, the growth rate of these variables will be included in the model.

TABLE3
CONTRASTS OF UNITARY ROOT

Unitary Root Contrast	**Common**	**Individual**	**Individual**	**Individual**
Variable	Levin, Lin & Chu t*	Im, Pesaran and Shin W-stat	ADF - Fisher Chi-square	PP - Fisher Chi-square
SMR	0.002	0.000	0.000	0.009
AFS	0.000	0.000	0.000	0.000
TDES	0.000	0.000	0.000	0.545
TA	0.000	0.019	0.001	0.000
INFL	0.000	0.000	0.000	0.000
INCPROD	0.000	0.000	0.000	0.000
PRESTSOC	0.206	0.562	0.275	0.091
PTFT	0.013	0.982	0.673	0.737
EMPTEM	0.208	0.946	0.662	0.928
D_PRESTSOC	0.000	0.000	0.000	0.000
D_PTFT	0.000	0.000	0.000	0.000
D_EMPTEM	0.000	0.000	0.000	0.000

In each case, there appears the P-value of contrast H0: “Presence of Unitary Root”.

Model results, estimated by fixed effects, without policy or ideology variables are presented in equation (1) (standard deviations are presented in parentheses)

$$SMR_{i,t} = \underset{(0.02)}{0.44} - \underset{(0.07)}{0.28}\, AFS_{i,t} + \underset{(0.07)}{0.16}\, INCPROD_{i,t} + U_{i,t} \quad (1)$$

First, the only two economic variables that explain the differences in the relative minimum wage are the union affiliation ratio and increases in productivity.

In order to correctly interpret the results obtained, it should be considered that, while it is true that collective bargaining may be an appropriate mean for

setting minimum wages, there are only few countries that rely exclusively on collective bargaining to set minimum wages. These are countries where collective agreements apply to the vast majority of workers (Denmark, Sweden, Finland, Iceland and Norway). However, in most countries, the coverage of collective bargaining is insufficient, which means that governments of many countries have adopted minimum wages through legislation (ILO). Precisely the countries that are the object of our study.

Specifically, it can be observed that the relative minimum wage depends negatively on the union affiliation ratio[4]. This result indicates that an increase in union affiliation ratio tends to increase wages in the economy to a greater extent than to influence legal minimum wages, which may or may not reflect collectively bargained minimum levels. The consequence of this is that it tends to reduce the relative minimum wages in countries that set them by legislation, revealing that the level of these minimum wages is secondary in collective bargaining.

In spite of the fact that beforehand this result seems to contradict Boeri (2012) results, it actually complements them. This paper does not compare minimum wages among countries with different minimum wage determination mechanisms as is done in Boeri (2012); we simply conclude that, in those countries in which the decision lies with the government, when union membership increases, relative minimum wages decline.

On the other hand, the relative minimum wage depends positively on the increase in productivity, which indicates that increases in productivity are more related to the minimum wage than to the average wage.

Next, we estimate the effects of the government's political position on the determination of the statutory minimum wage. For this, we use the dichotomous variables explained in section 3. Model I classifies the policy in three cases (Left, Center and Right), while Model II classify it in five cases (adding Center-Right and Center-Left to The previous classification).

As can be seen in Table 4, Model I indicates that the relative minimum wage is significantly lower in those countries ruled by a right-wing party, in particular 1.4% lower. When we detail the political position more, as shown in Model II, it is observed that the only variable that is significant is the Center-Right, indicating that governments with that political position are those who establish a lower relative minimum wage.

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[4] Robust estimations were made for the presence of autocorrelation and the result was maintained, resulting even in the effect being more significant.The possibility that the result was given by a possible instantaneous correlation of AFS variable with the rest, generating multicollinearity, was also explored. The instantaneous correlations are not very large and the level of significance of the variable was maintained in all the model specifications (incorporating variables one by one, two by two, etc.). Therefore, the result is quite robust.

TABLE 4
ESTIMATION - POLICY EFFECTS ON RELATIVE MINIMUM WAGES

	Model I		**Model II**	
Variable	Estimation	SD	Estimation	SD
constant	0.458	0.010	0.458	0.010
Right	–0.014	0.004	–	
Center-right			–0.015	0.004
Center	–		–	
Center-left			–	
Left	–		–	
AFS	–0.292	0.039	–0.293	0.039
INCPROD	0.118	0.067	0.129	0.067
R2	**0.852**		**0.852**	

Generally speaking, it is considered that all center-right positioned governments are related with more liberal positions, but that is not entirely accurate. Governments that are in principle more on the right may have more liberal economic policies, whereas the Christian Democratic governments, which are closer to the center, tend to be more interventionist. Therefore, it seems reasonable that ideology of the ruling party also has influence on the minimum wage determination.

As can be deduced from Table 5, liberal ideology governments have a relative minimum wage lower than governments of social ideology. In addition, governments shown as "other ideology " have a relative minimum wage lower than social ideology governments but equivalent to that of liberal ideology. In this sense, it can be concluded that social ideology tends to have a relative minimum wage between 1.3% and 1.4% higher.

TABLE 5
ESTIMATION - IDEOLOGY INFLUENCE ON RELATIVE MINIMUM WAGES

	Model III	
Variable	Estimation	SD
constant	0.454	0.010
Social	–	
Liberal	–0.013	0.005
Other	–0.014	0.005
AFS	–0.274	0.039
INCPROD	0.127	0.068
R2	**0.850**	

Therefore, there are no differences among the remaining ideologies. So the result shown in Table 5 would indicate that, among the governments without social ideology, it is not so much the ideological position the one that determines the minimum wage, but its political position.

Although the results of Tables 4 and 5 indicate that the political position, but also the ideological position of the governments, are significant variables in determining relative minimum wages, a final experiment is carried out to confirm the results. Thus, variables LRGEN and LRCON are included in the original model. These variables measure the general policy and economic policy government positions, respectively. These variables constructed from CHES take values on a scale of 0 to 10.

TABLE 6
ESTIMATION - EFFECTS OF GENERAL POLICY AND ECONOMIC POLICY (CHES)

	Model IV		**Model V**	
Variable	Estimation	SD	Estimation	SD
constant	0.470	0.012	0.469	0.012
LRGEN	–0.004	0.001		
LRCON			–0.004	0.001
AFS	–0.287	0.039	–0.279	0.039
INCPROD	0.124	0.067	0.126	0.067
R2	**0.850**		**0.851**	

As Table 6 shows, again the political position of the ruling party is relevant in determining the relative minimum wage. For each point in the index that a government leans to the right, the SMR is reduced by 0.4%. The same result is obtained when we consider the economic policy position, in which, for each point that a government leans to the right, the minimum wage is reduced by the same amount, 0.4%.

5. Conclusions

Literature has focused on explaining the effects that minimum wages have on economic or social issues (employment, poverty or inequality), but has paid less attention to the factors that determine these statutory minimum wages.

Despite the fact that in most countries, minimum wage determination is carried out by law, it is not clear what the determining factors are. In this paper we study the effects on minimum wages of the political and the ideological position of the ruling party. This is important because if only economic factors or the influence of pressure groups are those that endogenously determine the

minimum wage, the whole political debate about minimum wages would be empty of real content.

This topic has been addressed in studies on other countries, fundamentally the United States and Canada, and a significant influence of politics has been found in minimum wage determination. In this paper we focus on the European Union since, in addition to presenting an important novelty, it constitutes an ideal framework for the study of the issue. The European Union displays a greater diversity among policies and ideologies than other studies focused on a single country, but also enough homogeneity for other external factors such as migration or monetary policy not affect the results.

The outcomes suggest that, as an economic control variable, the increase in productivity has a significant effect on relative minimum wages. In addition, as in the literature, we have found out that pressure groups also influence the minimum wage, since the union affiliation ratio is significant. However, in contrast to previous works, it is found that the sign of this effect is negative in the case of countries that establish the minimum wage by legislative means.

Additionally, it is estimated that there is a significant effect of both politics and ideology in determining the statutory minimum wage. There is a negative effect on relative minimum wages if the government is center-right. As for ideology, it is found that the relative minimum wage tends to be higher if the government has a social ideology. When we repeat the research with the political position index obtained from the Chapel Hill Expert Survey, it is found that an increase in the index, that is to say a rightward shift, leads to a reduction in the minimum wage in relative terms.

To sum up, the above results show that in the EU, the minimum wage policy is partially determined by society through the political and ideological position of parties elected to govern.

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Appendix

TABLE A1
CHARACTERISTICS OF THE POLITICAL IDEOLOGIES CONSIDERED IN THE EU MEMBER STATES

Ideology	Basic general characteristics
Communist	Communist parties primarily adhere to Marxism developed by Karl Marx and Friedrich Engels in the 19th century. Their aim is the free and classless society based on common ownership of the means of production. These parties intend to overthrow the present capitalist system through revolutionary action of the working class. Recent political developments in European states would classify them as radicals and populists.
Socialist	Advocate a strong welfare state. Propose a reorganization of the current socio-economic order through a greater weight of the public sector, workers' control over the work process and redistributive tax policies. In general, they emphasize values such as equality, solidarity and social justice.
Social democratic	They are center-left parties in the political spectrum. They advocate a democratic welfare state and a mixed economy that contains privately-owned and state-owned enterprises. These parties adhere to values as freedom, equality, solidarity and social justice. Since the 1990s, most of them incorporated economically liberal topics such as limited social welfare, privatizations, deregulations and lower company taxes (Third Way).
Social liberal	With a thought of liberal base, they have an ideology centered on civil rights and promote an economic system that combines the needs of economic freedom with social justice, equal opportunities and solidarity.
Christian democratic	Inspired by Christian social doctrine, have as its basic principle human dignity. They are very supportive of family values, advocate Christian ethical and adhere to principles as freedom and solidarity. These parties oppose any form of secularism and, in general, advocate a social market economy (just like social liberals).
Liberal	Originating in the tradition of political liberalism (18th century movement). The doctrine of liberalism considers personal freedom to be the most important goal. In particular it favours free markets, free trade, limited governments, low taxes and private property (economic liberalism) as well as equality for all citizens under the law, civil rights, secularism and freedom of speech, press and religion.
Liberal conservative	It is a moderate version of political liberalism. It combines conservative policies with more liberal positions such as non-regulation of economic activity. It is a somewhat eclectic mix of liberal and conservative ideologies.

Ideology	Basic general characteristics
Conservative	These are usually middle-class organizations that seek to preserve established traditions and the current *status quo* of a society. They normally advocate traditional values such as authority, nation, religion, family, stability and continuity. They promote some liberal values, especially on economic issues (free market policies).
Nationalist	Nationalist parties believe that the nation and its sovereignty are of primary importance. This involves a strong identification with the nation state and its symbols. It usually also includes negative views of other nations and are against further European integration. On occasions it is combined with conservative ideology.
Independentist	Advocates a complete political secession of a particular region with its ethnic, linguistic or cultural identity and the formation of a new state. They emerge fundamentally in Eastern European countries and the former republics of the Soviet Union.

Source: Own elaboration based on the classification of www.parties-and-elections.eu

TABLE A2
AVERAGE DATA OF THE MOST RELEVANT VARIABLES ANALYZED.
EU MEMBER STATES CONSIDERED (1990-2015)

Country	Relative Minimum Wage (SMR)	General Policy government position (LRGEN) Rango 0-10[5]	Economic Policy government position (LRECON) Rango 0-10[3]	Union affiliation ratio (AFS)	Productivity increase (INCPROD)
Belgium	45,4%	5,7	6,0	53,8%	0,9%
Bulgaria	38,8%	5,6	5,7	27,2%	3,1%
Croatia	38,0%	5,8	4,4	34,7%	0,6%
Slovakia	35,0%	5,1	4,9	30,4%	3,3%
Slovenia	44,7%	5,2	5,7	41,2%	2,5%
Spain	30,7%	5,3	5,6	16,5%	0,6%
Estonia	31,6%	6,5	6,6	20,1%	4,3%
France	50,4%	5,9	5,3	8,2%	1,0%
Greece	36,4%	5,4	5,9	27,4%	0,9%
Hungary	34,8%	5,4	4,9	24,5%	1,8%
Ireland	42,3%	6,4	6,0	38,5%	2,3%
Latvia	32,4%	6,5	6,6	19,7%	4,4%
Lithuania	38,2%	5,1	5,2	13,1%	4,9%
Luxembourg	45,4%	6,4	4,7	41,1%	-0,2%
Malta	48,5%	6,3	6,1	59,4%	0,7%
Netherlands	44,5%	5,6	5,8	21,9%	0,9%
Poland	36,0%	5,9	6,3	19,9%	3,0%
Portugal	34,0%	4,8	5,3	22,7%	1,1%
UK	37,1%	5,9	6,2	30,5%	1,2%
Czech Rep.	31,7%	5,8	6,0	26,6%	2,3%
Romania	28,6%	4,7	4,6	43,6%	4,4%

[5] 0 = extreme left : 5 = center : 10 = extreme right.

The Impact of Structural Reforms on Economic Growth in Turkey: Evidence from Linear and Nonlinear ARDL Modeling*

El Impacto de las Reformas Estructurales en Turquía: Evidencia de Modelos ARDL Lineales y No Lineales

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Abstract

This paper investigates the relationship between structural reforms and economic growth in Turkey during the 1990-2019 period. Employing a novel database (the MONA database), it constructs structural reform indexes for the fiscal, financial, real, and trade sectors with two different approaches (z-score and min-max). The study uses both the linear ARDL and nonlinear ARDL (NARDL) models to provide additional robust evidence of the response of economic growth to structural reforms. The findings indicate that financial, fiscal, real, and total structural reforms have positive and statistically significant effects on economic growth in Turkey, although the growth potential of trade structural reforms seems not to have been realized.

Key words: *Structural Reforms, Economic Growth, ARDL Model, Turkish Economy.*

JEL Classification: *O23, O24, O40, C22.*

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Resumen

Este trabajo investiga la relación entre las reformas estructurales y el crecimiento en Turquía para el periodo 1990-2019. Utilizando una nueva base de datos (MONA), se construyen índices de reformas fiscal, financiera, real y comercial. Se utilizan modelos ARDL lineales y no lineales que proveen evidencia robusta de la respuesta del crecimiento a las reformas. Se encuentra que todas las reformas, a excepción de la comercial, han afectado significativa y positivamente.

Palabras clave: *Reformas estructurales, crecimiento económico, modelos ARDL, Turquía.*

Clasificación JEL: *O23, O24, O40, C22.*

1. Introduction

Following the global financial crisis of 2008, governments in both developed and developing countries have taken significant action to strengthen economic recovery; however, the global economy is still fragile and remains clouded by trade tensions, geopolitical conflicts, and an uncertain economic-political environment. Global growth, which fell to 2.9% in 2019–its lowest level since the financial crisis–is expected to remain well below its precrisis potential of 4%-4.5% over the next two years (The Organisation for Economic Co-operation and Development [OECD], 2019; International Monetary Fund [IMF], 2019). These recent challenges, including the low growth trap, have heightened the need for structural reforms (SRs); briefly, these refer to the major changes in the structures of the economic and social institutions in an economy. SRs are emphasized as a significant part of achieving strong and sustainable economic growth (Ostry, *et al*., 2009; Babecky and Havranek 2014; Marrazzo and Terzi 2017; Mizutani *et al*., 2018) through improvements in employment (Bouis and Duval, 2011; Bordon *et al*., 2016; Krebs and Scheffel, 2016; Almeida and Balasundraham, 2018), productivity (Salgado, 2002; Lusinyan, 2018; Bouis and Duval, 2011; Arnold and Barbosa, 2015; Gouveia *et al*., 2017; Kouamé and Tapsoba, 2019), foreign direct investments (Campos and Kinoshita, 2008), trade openness and market efficiency (Swaroop, 2016), and economic resilience (IMF, 2015).

This view has directed governments to carry out comprehensive SR programs to strengthen their macroeconomic performance and has raised researchers' interest in investigating the growth effects of SRs. However, SRs are seen as more difficult to measure than conventional economic policies, restricting the scope for a quantitative analysis of their effects. Therefore, much of the research to date has mostly used proxies for SRs (see Khan and Qayyum, 2006; Bara *et al*., 2016; Şahin and Akar, 2018; Yu *et al*., 2014; Mizutani *et al*., 2018), such as liberalization indexes (see Christiansen *et al*., 2013; Prati *et al*., 2013; Arnold

and Barbosa, 2015; Bekaert *et al*., 2001; Norris *et al*., 2016), and certain indicators, such as employment protection legislation (EPL), product market regulation (PMR) and regulation in energy, transport, and communications (ETCR) (see Egert and Gal, 2016; Amable *et al*., 2016; Fatas, 2015, Brancaccio *et al*., 2018). Although these proxies or indicators can be useful for measuring SRs, they may not provide a comprehensive and direct picture of SRs. Considering this gap in the literature, Kouamé and Tapsoba (2019) constructed new SR indexes for four key sectors (namely, the fiscal, financial, real, and trade sectors) to assess the effects of SRs on labor productivity growth in 37 developing countries by employing a novel database (IMF-Monitoring of Fund Arrangements [MONA] database). The MONA database is an IMF-maintained database used to monitor comparable data related to the economic objectives and outcomes of Fund-supported arrangements and indicates the cumulative history of Fund-supported programs from Executive Board approval through their completion. Following the study of Kouamé and Tapsoba (2019), the present study constructs new SR indexes for Turkey to explore the growth effects of SRs in those sectors during the period 1990-2019. Faced with heightened uncertainty in the economic-political environment, continued geopolitical conflicts in the Middle East, and a low-growth trap, the Turkish economy is considered to be one of the developing economies most in need of SRs and, thereby, provides an interesting field for such an analysis. To the best of our knowledge, this is the first study investigating the growth effects of SRs in four sectors in Turkey by constructing new SR indexes for the country, even if it is not the first to employ the MONA database. This study uses two different approaches (namely, the z-score and min-max approaches) to construct SR indexes and employs the standard, or linear, ARDL (autoregressive distributed lag) and nonlinear ARDL (NARDL) methodologies to estimate the econometric models in order to confirm the robustness of the link between SRs and economic growth.

The remaining part of the study proceeds as follows. Section 2 reviews the literature on the link between SRs in the fiscal, financial, trade, and real sectors and economic growth. Section 3 describes the data, variables, and approaches used to construct the SR indexes. Section 4 is concerned with the methodology used in the study, and the last section focuses on the main conclusions.

2. Literature Review

This section reviews the empirical literature on the link between SRs and economic growth and the channels through which SRs impact the growth performance of countries. There is a large and growing body of literature relevant to the topic that postulates that SRs could be powerful tools for economic growth and development, even if growth responses to SRs vary across countries. However, this study focuses on the literature that deals directly with the growth effects of the four key SRs (fiscal, financial, trade, and real sector reforms). First, *fiscal reforms* could play a critical role in supporting strong and long-lasting economic

growth by ensuring macroeconomic stability and boosting private investment, employment, and productivity (IMF, 2015). Using the difference-in-differences approach, Ding *et al.* (2019) estimated the impact of the tax sharing system (TSS) reform on economic growth in China. In particular, they found that the TSS reform resulted in per capita GDP growth rates that were approximately 18% higher than the average growth rates in the pre-reform period. Employing the synthetic control method, Ormaechea *et al*. (2017) analyzed the impact of nine fiscal reform episodes on economic growth in seven high-income countries. They found that the reform countries achieved a higher annual real GDP growth rate and that the countries that were initially less developed experienced larger growth effects after their reforms. Likewise, employing province-level panel data from mainland China for the period 1970-1993, Lin and Liu (2000) found that fiscal decentralization has made a significant contribution to per capita GDP growth, mainly by improving the efficiency of resource allocation.

Second, *financial reforms* are expected to exert a positive effect on economic growth because they remove financial restrictions and lower the cost of capital (Kouamé and Tapsoba, 2019), mobilize savings and then allocate credit to productive activities, and create favorable conditions in financial institutions (Hasan *et al*., 1996). Using an indicator variable for equity market liberalization, Bekaert *et al.* (2001) provide evidence that stock market liberalization has a positive and statistically significant impact on per capita GDP. This result is robust to a variety of experiments, including those using different country groups, different time horizons for measuring economic growth, and alternative sets of liberalization dates. Christiansen *et al*. (2013) examined the simultaneous effects of different types of economic reforms by constructing a domestic financial liberalization indicator and reported that domestic financial reforms are robustly associated with faster growth. Employing the pooled mean group approach, Aksoy (2019) found a long-term positive relationship between financial reforms and real per capita GDP in 33 developing countries during the period 1973-2016. However, using a dummy variable that takes on the value of one from the year a country launched its financial reforms onward and zero in the contrary case, Bara *et al*. (2016) found that financial reforms are not sufficient to drive economic growth.

Third, existing research recognizes the key role played by *trade reforms* in the economic growth performance of an economy by reducing trade barriers among countries, improving efficiency in the production process, and fostering physical capital accumulation (Wacziarg and Welch, 2008; Salinas and Aksoy, 2006; Khan and Qayyum, 2006). Employing an unbalanced panel dataset on 150 countries during the period 1995-2015, Gnangnon (2018) found that economic growth is strongly associated with multilateral trade liberalization in both the entire sample and different subsamples. In the same vein, using three different liberalization indicators in a dynamic panel framework, Greenaway *et al*. (2002) found that liberalization has a positive effect on economic growth, even if the effect would appear to be relatively modest and lagged. However, the growth potential of trade reforms may not always be realized. While most trade-centered reforms have been successful, in some cases, they have not had a meaningful impact on

growth because they target the wrong problems, have incoherent policies, and lack credibility (Hallaert, 2010)). In this context, Wacziarg and Welch (2008) showed that countries that tended to deepen trade reforms experienced a higher annual growth rate, while countries that tended to have suffered from political instability were faced with negative or zero growth performance after liberalization. They also showed that post-liberalization investment rates increased 1.5-2.0 percentage points, confirming that liberalization boosts economic growth through its effect on physical capital accumulation. A comprehensive study conducted by Irwin (2019) reviewed three strands of recent work on the relationship between trade reforms and economic growth: synthetic control methods studying specific reform episodes, cross-country regressions considering within-country growth, and studies investigating the channels through which restrictions on trade barriers may promote higher productivity. The study reported that trade reforms are positively associated with economic growth, on average, even if the growth effect of these reforms is heterogeneous across countries.

Fourth, it has been observed that *real sector reforms* can stimulate employment and investment (OECD, 2016), improve innovation and total factor productivity (Griffith and Harrison, 2004; Amable, *et al*., 2016), and therefore contribute to economic recovery and sustainable growth (Fatas, 2015; Bourles *et al*, 2010; Banerji *et al.*, 2017). By improving efficiency in productive factors and expanding flexibility, SRs in labor and product markets improve growth prospects and the ability of economies to adjust to shocks (Canton *et al.*, 2014). However, several lines of evidence have reported that there is no stable relationship between real sector reforms and growth. For example, Belot *et al*. (2007) found an inverse U-shaped association between employment protection and economic growth, while Brancaccio *et al*. (2018) suggested that there is no link between real sector reforms and economic growth.

In view of all that has been mentioned so far, one may suppose that SRs in the fiscal, financial, trade, and real sectors may play a critical role in supporting economic growth through different channels, although the growth responses to SRs in these sectors vary from country to country.

3. Datasets

This study covers the Turkish economy over a thirty (30) year period spanning from 1990 to 2019[1]. The data are obtained from three different sources. The SR indexes are computed by using the IMF-MONA database. Data on the real gross domestic product, real fixed capital investments, total natural resources, and research and development (R&D) investments are culled from the World Bank World Development Indicators (WDI), and data on the employed labor

[1] The reason why this study covers the 1990-2019 period is that the data on SR variables for Turkey are available in the MONA database for this period.

force and education level of the active population are collected from the Penn World Table (PWT-version 9.1).

3.1. The MONA Database and Construction of the SR Indexes

In constructing the financial, fiscal, real, trade, and total SR indexes, this study uses the IMF-MONA database and employs two different approaches (namely, the z-score and min-max approaches) to ensure the reliability of the indexes and the consistency of the empirical results.

The MONA database covers data prepared on the basis of comparable information on the targets and outcomes of Fund-supported regulations for SRs in these four key sectors. In this respect, the MONA database, which covers all the conditions of these regulations in countries within a Fund-supported program, presents the cumulative history of Fund-supported programs from Executive Board approval through its completion. Based on the data collected during the approval and on the review date of SRs since 2002, the MONA database includes structural reform data for 101 countries within the program for the 2002-2019 period. It also includes archival data on SRs for the 1990-2003 period, created by following a similar methodology for 90 of the 101 countries (for a list of these countries, see the MONA database: https://www.imf.org/external/np/pdr/mona/index.aspx).

Approval and evaluation of SRs in the MONA database are based on the policy commitments agreed upon by authorities in these countries, and these commitments are classified into four different forms: prior actions (PA), quantitative performance criteria (QPC), indicative targets (IT), and structural benchmarks (SB). PAs present the measures that countries in the program agreed to take on as SRs before the IMF Executive Board approved financing or completed review, ensuring the necessary basis for successful implementation by putting structural reforms back in focus if the reforms diverge from the agreed-upon commitments. QPCs related to macroeconomic variables controlled by country authorities are certain and measurable conditions that countries have to meet to pass a Board review. ITs set out indicative targets to assess the progress of the countries in the reform process and can be set in the case of missing QPCs due to data uncertainty in economic trends, and they are converted to QPCs with convenient modifications as uncertainty decreases. SBs are nonquantifiable reform measures that vary across programs and are crucial for achieving program targets and for assessing program implementation during review (IMF-MONA database, 2019). SBs in countries within the program are grouped into four specific categories by economic classification according to their identifications and codes in the MONA database, as shown in table (1).

Here, the financial reforms cover SRs in the banking and financial sectors to ensure the supervision of these sectors and to reduce regulation. Fiscal reforms cover SRs in public and fiscal sectors aimed at controlling expenditures and revenues in the public sector, managing foreign borrowing, and increasing fiscal transparency. Real sector reforms cover wage, price, and goods and labor

TABLE 1
DESCRIPTIONS OF STRUCTURAL REFORMS

Reforms	SB Codes	Description
Financial	2	2. Central bank 2.1. Central bank operations and reforms 2.2. Central bank auditing, transparency, and financial controls.
	6	6. Financial sector 6.1. Financial sector legal reforms, regulation, and supervision 6.2. Restructuring and privatization of financial institutions.
Fiscal	1	1. General government 1.1. Revenue measures, excluding trade policy 1.2. Revenue administration, including customs 1.3. Expenditure measures, including arrears clearance 1.4. Combined expenditure and revenue 1.5. Debt Management 1.6. Expenditure auditing, accounting, and financial controls 1.7. Fiscal transparency (publication, parliamentary oversight) 1.8. Budget preparation (e.g., submission or approval) 1.9. Inter-governmental relations.
	4	4. Pension and other social sector reform 4.1. Pension reforms 4.2. Other social sector reforms (e.g., social safety nets, health and education).
	10	10. Economic statistics (excluding fiscal and central bank transparency and similar measures).
	11	11.4 Anti-corruption legislation/policy.
Real	3	3. Civil service and public employment reforms, and wages.
	5	5. Public enterprise reform and pricing (non-financial sector) 5.1. Public enterprise pricing and subsidies 5.2. Privatization, public enterprise reform and restructuring, other than pricing 5.3. Price controls and marketing restrictions.
	9	9. Labor markets, excluding public sector employment.
	11	11. Other structural measures 11.1. Private sector legal and regulatory environment reform (non-financial sector) 11.2. Natural resource and agricultural policies (excl. public enterprises and pricing) 11.3. PRSP development and implementation.
Trade	7	7. Exchange systems and restrictions (current and capital).
	8	8. International trade policy, excluding customs reforms.

market regulations. Trade sector reforms cover SRs in international trade policy, exchange systems, and current and capital accounts.

Using data on successful SBs (met, implemented with delay, and modified structural benchmarks) and considering the data range (approval data-initial end date) in the implementation process of the SRs, the SR indexes were computed in three stages. In the first stage, the data ranges (three years for all reforms) for the implementation of SRs in Turkey during the 1990-2019 period were

determined, and the number of SRs during this period was summed after the SRs were grouped into financial, fiscal, trade, and real sector reforms[2]. In the second stage, the SRs were extended to take on the same values from the approval date to the initial end date. These two stages were conducted in a similar manner for all SRs in the sample period, and the number of financial, fiscal, trade, real, and total SRs in the Turkish economy was obtained based on the data ranges in the implementation process. By performing the above two steps, SR indexes were computed by considering the effects of SRs during the implementation process (within a certain date range). In the third stage, the SR indexes were computed by employing the z-score (ZS) and min-max (MM) normalization methodologies[3]. Each normalization methodology relies on classifying the data in terms of its distribution over a certain range when the numerical differences between the data are high, as in the SB data in this study, and allows data of different scales to be compared (OECD, 2008: 27-30).

The ZS approach converts a given variable, which is characterized by its mean and standard deviation, into an index by the reduced-centered normalization methodology. The normalization of data in the ZS approach is based on the following equations (Nardo *et al*., 2005: 60; OECD, 2008: 84).

$$ZS = \left(\frac{(X - \mu)}{\sigma} \right) \tag{1}$$

In equation (1), ZS follows a reduced-centered normal distribution, with a standard deviation of one and a mean of zero, if X is normally distributed. With this standardization, SR variables formed by using successfully met SB data can be expressed in the same units (namely, standard deviations) and can therefore be meaningfully compared in terms of their effects. In this way, the normalized SR indexes for the Turkish economy are computed for the 1990-2019 period by using the following equation:

$$\text{Structural Reform Index}_{ct} = \left(\frac{\left(SB_{ct} - SB_{c\mu} \right)}{SB_{c\sigma}} \right) \tag{2}$$

where (SB_{ct}) indicates the total number of SBs successfully met in Turkey (c) during the last review by the IMF board in year (t). ($SB_{c\mu}$) and ($SB_{c\sigma}$) indicate the mean and standard deviation of the number of SRs in Turkey during the

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2 The number of SRs in Turkey during the sample period is shown in table (3) in the appendix. Descriptive statistics for the SRs and the other variables used in the econometric analysis are shown in table (4) in the appendix.

3 In contrast to the z-score, min-max scaling results in smaller standard deviations. Therefore, this study also used min-max normalization to reduce the effects of outliers and to check the robustness of the estimated effects of SRs on economic growth.

sample period, respectively. If the total number of successful SBs is equal to the mean number of SBs, then SRI takes on the value zero.

3.2. Other Macroeconomic Data

Together with the SR indexes, this study also includes six different macroeconomic variables (namely, real gross domestic product (RGDP), real fixed capital investments (RGFI), total natural resource rents (NR), research and development investments (R&D), the employed labor force (EL), and the education level of the active population (EI)). Data on RGDP (representing economic growth as a dependent variable) were obtained from the WDI in real per capita terms. Data on NR (the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents) were obtained from the WDI in nominal USD as a share of GDP. Data on R&D (representing the level of technological development) were also obtained from the WDI in nominal USD as a share of GDP. The EI variable was used to represent the qualitative dimension of human capital accumulation. Based on the average duration of schooling for the different educational levels in the working-age population, data on this variable were obtained from the PWT database as the education index in per capita terms.

In addition, some of the variables were transformed before being used in estimations. For example, data on the RGFI obtained from the WDI variable were computed in per capita terms by dividing real fixed capital investments by the total population (obtained from the same database) in the middle of the year. The EL variable was used to represent the quantitative dimension of human capital accumulation. Data on this variable obtained from the PWT were computed by dividing the active labor force series obtained from the PWT database by the total population (obtained from the same database) in the middle of the year. Table (2) summarizes the definitions and sources of the variables.

TABLE 2
DEFINITIONS AND SOURCES OF THE VARIABLES

Variables	Definitions	Sources
RGDP	Real Gross Domestic Product (2010-USD).	The World Bank-WB (World Development Indicators-WDI-2019).
RGFI	Real Fixed Capital Investments (2010-USD).	
NR	Total Natural Resources Rents	
RD	R&D Investments	
EL	Employed Labour Force	Penn World Table-PWT (PWT Version 9.1-2019).
EI	Education Level of Active Population	

Variables	Definitions	Sources
FNSR	Financial Structural Reforms	International Monetary Fund-
FSSR	Fiscal Structural Reforms	MONA Database-2019
RESR	Real Structural Reforms	(Arrangements, 2002-Current Full
TRSR	Trade Structural Reforms	Dataset).
TOSR	Total Structural Reforms	Authors' self-calculation.

This study uses the logarithmic values of the RGDP, RGFI, NR, RD, EL, and EI variables and the level values of the SR indexes. Descriptive statistics of the variables used in the econometric analysis are shown in table (4) in the appendix.

4. Methodology and Findings

In this study, econometric models estimated to detect the growth effects of SRs in Turkey are based on an extension of the Cobb-Douglas (CD)-type stochastic total production function developed by Solow (1956) within the neoclassical growth model. Considering the development of theories on the determinants of economic growth, CD-type production functions can be extended by including the technological development level and other potential determinants of economic growth within the scope of the modern (endogenous) growth theories developed by Romer (1986), Lucas (1988) and Barro (1990). For some basic studies in this context, see Barro (1991), Mankiw *et al*. (1992), Sala-i-Martin (1997), Rodrik (2012), and Alagidede *et al*. (2016). In this way, a CD-type production function can be written as follows:

$$Y_t = A_t K_t^{\alpha} L_t^{\tau} E_t^{\rho} N_t^{\sigma} SR_t^{\gamma} \mu_t^{\delta} \tag{3}$$

where (μ_t) indicates the error term; (E_t) indicates the educational level of the active population; (N_t) indicates the level of natural resources; (L_t) indicates the employed labor force; (K_t) indicates physical capital accumulation; (A_t)[4] indicates the technological development level; and (SR_t) indicates financial, fiscal, trade, real, or total structural reforms.

By taking the natural logarithm of both sides of equation (3), the general form of the extended CD-type production function can be rewritten as follows:

$$Y_t = \alpha + \partial_t RD_t + \alpha_t K_t + \tau_t L_t + \rho_t E_t + \sigma_t N_t + \gamma_t SR_t + \varepsilon_t \tag{4}$$

[4] Considering the evolution of modern growth theory, the technological development level (A_t) is assumed to be composed of R&D investments that directly reflect the level of technological development, rather than the number of patents, foreign direct investment, the openness ratio, etc. (Romer, 1990: 71-101; Grossman and Helpman, 1994: 23-44). Therefore, the level of technological development in the extended CD-type production function can be expressed as $A_t = f(RD)_t^{\partial}$.

In this context, this study estimates the following econometric model for Turkey for the period 1990-2019 by employing ARDL and NARDL models[5], which depend on the unrestricted error correlation model (UECM). Based on Pesaran *et al*. (2001) and Shin *et al*. (2014), the ARDL and NARDL models, which use lagged values of the variables to address autocorrelation and endogeneity issues, are designed to investigate the linear and nonlinear short- and long-term relations among variables that are integrated of different orders, [I(0)], [I(1)] or a combination of them.

$$RGDP_t = \alpha + \beta_1 RGFI_t + \beta_2 EL_t + \beta_3 EI_t + \beta_4 NR_t + \beta_5 RD_t + \beta_6 SR_t + \varepsilon_t \tag{5}$$

where (α) indicates the constant term; (β) indicates the slope coefficients; and (ε) indicates the error term. As the SR indexes are represented by five different variables, five different variations of the basic model defined in equation (5) are estimated to avoid multicollinearity. The short- and long-term symmetric relations between the two variables (as (y_t) and (x_t)) are investigated in the ARDL (p, q) model with the following equation:

$$y_t = \sum_{i=1}^{p} \lambda_i y_{t-i} \sum_{i=0}^{q} \delta_i^{*'} x_{t-i} + \varepsilon_t \tag{6}$$

where (y_t) is the dependent variable; (x_t) is the external variable vector with (k x 1) dimensions; (p, q) indicates the distributed lag values of the (y_t) and (x_t) variables, respectively; $\left(\delta_i^{*'}\right)$ indicates the (k x 1) dimensional coefficient vector for the external variables; (λ_i) indicates the scalar vector; and (ε_t) indicates the error term with mean zero and finite variance. Equation (6) can be written in symmetric and UECM forms as follows:

$$\Delta y = \phi y_{t-1} + \beta_i^{'} x_t + \sum_{i=1}^{p-1} \lambda_i^{*} \Delta y_{t-i} + \sum_{i=0}^{q-1} \delta_i^{*'} \Delta x_{t-i} + \varepsilon_t \tag{7}$$

Given that $\phi = -1\left(1 - \sum_{j=1}^{p} \lambda_j\right)$, $\beta_i = \sum_{i=0}^{q} \delta_i$, $\lambda_i^{*} = \sum_{m=i+1}^{p} \lambda_m$ with $i = 1, 2, \ldots p - 1$ and $\delta_i^{*} = \sum_{m=i+1}^{q} \delta_m$ with $i = 1, 2, \ldots q - 1$, equation (7) can be rewritten as follows:

$$\Delta y_t = \phi(y_{t-1} - \theta_i^{'} x_{t-1}) + \sum_{i=1}^{p-1} \lambda_i^{*} \Delta y_{t-i} + \sum_{i=0}^{q-1} \delta_i^{*'} \Delta x_{t-i} + \varepsilon_t \tag{8}$$

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[5] This study uses the EViews 10.0 and WinRATS 9.2 packages to estimate the defined models.

where $\left(\theta = -\left(\frac{\beta}{\phi}\right)\right)$ indicates the coefficients computed for the long-term relation between (y_t) and (x_t); $\left(\lambda_i^*\right)$ and $\left(\delta_i^*\right)$ indicate the short-term coefficients calculated for lagged values of the changes in (y_t) and (x_t), respectively; and (ϕ) indicates the symmetric error correction coefficient. The error correction coefficient shows the speed of the adjustment of (y_t) from disequilibrium (because of shocks in (x_t)) to the long-run equilibrium and is expected to be between 0 and –1 (Pesaran *et al*., 2001: 290-310).

The NARDL (p, q) model, which is based on an extension of equation (7) to include asymmetric relations among the variables and asymmetric short- and long-run relationships between (y_t) and (x_t), can be investigated with the following regression equation.

(9) $$y_t = \beta^+ x_t^+ + \beta^- x_t^- + u_t$$

(10) $$x_t = x_0 + x_t^+ + x_t^-$$

where (β^+) and (β^-) indicate long-run asymmetric parameters related to (x_t^+) and (x_t^-); (u_t) shows deviations from the long-run equilibrium; and (x_t) consists of two components, (x_t^+) and (x_t^-), which indicate the partial sums of positive and negative changes. Equation (10) can be rewritten by separating the partial sums of the positive and negative changes in (x_t) as follows.

(11) $$x_t^+ = \sum_{j=1}^{t} \Delta x_j^+ = \sum_{j=1}^{t} Max\left(\Delta x_j, 0\right)$$

(12) $$x_t^- = \sum_{j=1}^{t} \Delta x_j^- = \sum_{j=1}^{t} Min\left(\Delta x_j, 0\right)$$

After inserting these two components of (x_t) into the ARDL model, the NARDL (p, q) model that allows the detection of the effects of positive and negative changes in (x_t) on (y_t) can be expressed in UECM form as follows (Shin *et al*., 2014: 285-290):

(13) $$\Delta y_t = \phi\left(y_{t-1} - \theta_1' x_{t-1}^+ - \theta_2' x_{t-1}^-\right) + \sum_{i=1}^{p-1} \lambda_i \Delta y_{t-i} + \sum_{i=0}^{q-1} \delta_{1i}^{*'} \Delta x_{t-i}^+ + \sum_{i=0}^{q-1} \delta_{2i}^{*'} \Delta x_{t-i}^- + \varepsilon_t$$

From equation (13), the presence of asymmetric short- and long-run relationships among the variables (x_t) and (y_t) can be tested by the standard Wald test. In this context, this study examines short-run symmetry (W_{SR}), where $\left(\delta_i^+ = \delta_i^-\right)$, and long-run symmetry (W_{LR}), where $(\theta = \theta^+ = \theta^-)$.

Based on Sek (2017) and Lacheheb and Sirag (2019), this study estimates the ARDL and NARDL models defined in equation (8) and equation (13) in five stages. In the first stage, the stationarity conditions of the variables are examined by using unit root tests to confirm that none of the series are integrated beyond I(1)[6]. In the second stage, the optimal lag lengths of the ARDL and NARDL models are detected by using the Schwarz information criterion (SIC). In the third stage, the long-run linear and nonlinear cointegration relations between the dependent and independent variables are investigated by the bound testing approach. This approach allows for an investigation of whether there are long-term cointegration relationships among the variables when the series are of different orders (but they should not be I(2)). In the fourth stage, equations (8) and (13) are estimated by OLS (ordinary least squares) with a specification determined by the SIC, and the short- and long-term symmetric-asymmetric ARDL coefficients for the independent variables are computed. In the last stage, diagnostic tests including tests for heteroskedasticity, autocorrelation, and normality, for the estimated ARDL and NARDL models are performed, and whether the models meet the stability conditions is investigated. In addition, to determine the direction and degree of the relationships between the economic growth and SR variables, this study also performs the weak exogeneity tests developed by Hendry and Mizon (1998). According to the exogeneity Wald test results, the variables appear to be weakly exogenous for the parameters of interest (see table 8 in the appendix). This result implies that a model in which either the economic growth or SR variables are the dependent variable can be established. However, since this study aims to examine the effects of SRs on economic growth, the SR variables are accepted as the exogenous variables, while economic growth is accepted as the endogenous variable.

Since the stationarity condition of the variables is the first and most basic step in the estimation of the ARDL and NARDL models, the stationarity of the variables is investigated by using linear (augmented Dickey-Fuller [ADF] and Phillips-Perron [PP]) and nonlinear (Kapetanios, Shin and Snell [KSS] and Sollis [SLS]) unit root tests. The ADF and PP unit root tests developed by Dickey and Fuller (1976-1979) and Phillips and Perron (1988) can be used when the time series have linear trends and can be used to perform stationarity analysis under various assumptions to remove autocorrelation in the variables. In the ADF unit root test, it is assumed that the autocorrelation in the error terms is removed by adding the lagged values of the independent variable to the model, and accurately determining the degree of autocorrelation in the error terms is necessary to apply the test. In the PP unit root test, an assumption related to the distribution of the random shocks in the ADF test is developed, and stationarity analysis is carried out nonparametrically to control for the degree of correlation in the time series (Phillips and Perron, 1988: 335-46). In these two tests, if the

[6] As the ARDL model can be applied when the variables are I(0) or I(1), it is necessary to determine the order of integration of the variables to avoid spurious results.

test statistics computed in both constant and trend (CT) forms are higher than the critical values (calculated by MacKinnon (1996)) in absolute value, the null hypothesis that "the series has a unit root" can be rejected. On the other hand, the KSS and SLS unit root tests developed by Kapetanios et al. (2003) and Sollis (2009) can be used to perform stationarity analysis under various assumptions when the variables have symmetrical or asymmetrical properties. In the KSS unit root test, it is assumed that the asymmetric time series follows an exponential smooth transition autoregressive (ESTAR) process. The KSS test is given by the following specification:

$$\Delta y_t = \delta y_{t-1}^3 + \varepsilon_t \tag{14}$$

where (y_{t-1}^3) indicates ESTAR nonlinearity and (y_t) is the demeaned or detrended time series of interest. The equation is estimated by the least squares method, and the nonlinear t-statistics are computed with the formula $(t_{NL} = \hat{\delta} / s\hat{\delta})$. Here, $\hat{\delta}$ indicates the OLS estimate of δ, and $s\hat{\delta}$ indicates the standard error of $\hat{\delta}$. The null hypothesis of nonstationarity in the KSS test is $H_0 : \delta = 0$, which is examined against the alternative $H_1 : \delta < 0$ with equation (14). If the (t_{NL}) test statistics are lower than the KSS critical values (obtained from Kapetanios *et al*., (2003)), the null hypothesis that "the series has a unit root" cannot be rejected (Kapetanios *et al*., 2003:359-379).

In the SLS unit root test, it is assumed that symmetric or asymmetric time series follow either exponential or logistic smooth transition autoregressive processes. The SLS test is given by the following specification:

$$\Delta y_t = \delta_1 y_{t-1}^3 + \delta_2 y_{t-1}^4 + \varepsilon_t \tag{15}$$

where $\left(y_{t-1}^3\right)$ and $\left(y_{t-1}^4\right)$ indicate symmetric and asymmetric ESTAR nonlinearity. The null hypothesis of nonstationarity in the SLS test is $H_0 : \delta_1 = \delta_2$, which is examined against the alternative $H_0 : \delta_1 \neq \delta_2 \neq 0$ with equation (15). If the F-statistics are lower than the SLS critical values (obtained from Sollis (2009)), the null hypothesis that "the series has a unit root" cannot be rejected (Sollis, 2009:118-125).

Findings obtained from following the stages above are reported in tables (5), (6), and (7) in the appendix. The linear ADF and PP unit root tests reveal that all variables are stationary after the first difference (I(1)), while the results obtained from the KSS and SLS unit root tests indicate that the EL and EI variables are stationary at level (I(0)) and the other variables are stationary after the first difference (I(1)) (see table (5)). In short, all unit root tests concluded that all variables are not integrated of order two (I(2)); this fulfills the requirement to proceed to the ARDL and NARDL models.

As seen in Panel C in both table (6) and table (7), the null hypothesis that "there is no cointegration among the variables in the model" can be rejected,

as the FPSS bound test statistics are higher than the lower and upper bounds of the critical values taken from Pesaran *et al*. (2001) and Shin *et al*. (2014). Therefore, we can conclude that there is a long-run cointegration relationship between the dependent and independent variables in all ARDL and NARDL models defined in this study[7]. In addition, since the probability values of the test statistics calculated for the Ramsey reset (RR), Lagrange multiplier (LM) and autoregressive conditional heteroskedasticity (ARCH) tests are higher than 0.05 and the Cusum (CS) and Cusum of Squares (CS^2) test results are stable, the models are found to have passed the diagnostic tests, ensuring that there are no identification errors, autocorrelation, heteroskedasticity, or structural instability. For normality, it is seen that the residuals in the ARDL models are not normally distributed (except for Model 4), while residuals in the NARDL models are normally distributed (except for Model 4) since the probability values of the Jarque-Bera (JB) test statistics are lower and higher than 0.05 in the ARDL and NARDL models, respectively.

The symmetric and asymmetric short- and long-term coefficients computed for the explanatory variables in the ARDL and NARDL models are reported in Panel A and Panel B in both table (6) and table (7). The findings in both Panels B indicate that the coefficients on the error correction term (ECM_{t-1}) are statistically significant and take on values between 0 and -1 for both the ARDL and NARDL models. This shows that any disequilibrium that occurred in the short run because of symmetric/asymmetric shocks between the variables are removed in the long run.

Table (7) presents the results of the short- and long-run symmetry test for the pair research and development (RD) and economic growth[8]. According to the Wald test results, the null hypothesis of short- and long-run symmetry among RD changes can be rejected since the probability values of the test statistics W_{SR} $(RD = RD^{+} = RD^{-})$ and W_{LR} $(RD_i^{+} = RD_i^{-})$ are lower than 0.05. These results confirm that positive and negative changes in RD expenditures have a statistically significant effect on economic growth in both the short and long run.

The short-run ARDL estimates reported in Panel A in table (6) indicate that the significance and signs of the symmetric coefficients related to the conventional determinants of economic growth (RGFI, EL, EI, NR, RD) vary from period to period and model to model. For example, economic growth responds positively to real fixed capital investments (except in the one-period lag), the employed labor force and natural resources (except in model 4), and R&D investments or technological development (except in the current period and one-period lag).

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7 The lower and upper bounds are determined as 2.88-3.99 for the ARDL models and 2.73-3.90 for the NARDL models.

8 On the basis of the extended CD-type production function within the scope of endogenous growth theories, it is acknowledged that changes in technology affect the efficiency of other production factors. For this reason, asymmetry is considered for the RD variable. In other words, this study suggests that the effect of asymmetry may be caused by positive or negative shocks to R&D investments (because of technological shocks).

The educational level has a negative impact on economic growth, but the sign of the impact becomes positive after one lag. In regard to the SR indexes, the short-run linear estimates show that economic growth is positively associated with fiscal, financial, real, and total SRs, but no statistically significant effect from trade reforms is found. Specifically, all else being equal, an additional one-unit increase in financial, fiscal, real, and total SRs leads to increases in growth of 0.89%, 0.83%, 0.84%, and 0.83%, respectively. Additionally, the long-run ARDL estimates reported in Panel B in table (6) show that there is a statistically significant and positive association between economic growth and real fixed investments, the employed labor force, the educational level of the active population, total natural resources (except in model 4), and R&D investments or technological development. More importantly, the long-run linear estimates indicate that fiscal, financial, real, and total SRs have a positive and statistically significant impact on economic growth; however, no significant impact from trade reforms is found. Specifically, all else being equal, an additional one-unit increase in financial, fiscal, real, and total SRs leads to increases in growth of 0.73%, 0.69%, 0.69%, and 0.68%, respectively.

The short-run NARDL estimates reported in Panel A in table (7) indicate that the significance and signs of the asymmetric coefficients related to the conventional determinants of economic growth vary from period to period and model to model. For example, economic growth responds positively to the employed labor force, natural resources, and real fixed capital investments (except in the two-period lag). The educational level has a negative impact on growth, but the sign of the impact turns positive after one lag. A positive shock in technological development (RD) is also shown to positively affect economic growth, while a negative shock suggests otherwise (except in the two-period lag). In regard to the SR indexes, all short-run nonlinear estimates show that economic growth is positively associated with fiscal, financial, real, and total SRs, but no statistically significant effect from trade reforms is found. Specifically, all else being equal, an additional one-unit increase in financial, fiscal, real, and total SRs leads to increases in growth of 0.83% (0.65%), 0.78% (0.74%), 0.76% (0.64%), and 0.77% (0.73%), respectively. (The values in parentheses indicate the estimations for a one-period lag.) Additionally, the long-run NARDL estimates reported in Panel B in table (7) show that there is a statistically significant and positive association between economic growth and real fixed capital investments, the employed labor force, total natural resources (except in model 4), and the educational level of the active population. The only exception is that negative shocks to technological development (R&D) are found to be insignificant. More importantly, the long-run nonlinear estimates indicate that all SRs, except for trade reforms, have a positive and statistically significant impact on economic growth. Specifically, all else being equal, an additional one-unit increase in financial, fiscal, real, and total SRs leads to increases in growth of 0.96%, 0.96%, 0.91%, and 0.94%, respectively.

These findings point to SRs implemented in Turkey during the period 1990-2019 being potentially key factors that improved the growth performance of the

economy. This study also performs a sensitivity analysis to check the robustness of the effects of SRs on economic growth. In this context, the SR indexes are standardized using the min-max approach. Findings obtained using the same models (ARDL/NARDL) again indicate that all SRs, except for trade reforms, are strongly associated with economic growth in both the short and long run in Turkey over the sample period.

5. Conclusion

This study attempts to analyze the relationship between structural reforms and economic growth in Turkey during the 1990-2019 period. For this purpose, this study constructs financial, fiscal, real, trade, and total structural reform indexes using the MONA database and two different approaches (namely, z-scores and min-max standardization), whereas previous studies have mostly focused on liberalization indexes and proxy variables that may not directly measure structural reforms. To provide additional evidence of robustness, this study estimates five different models based on an extended Cobb-Douglas-type production function by employing both linear ARDL (autoregressive distributed lag) and nonlinear ARDL (NARDL) models.

The findings obtained from the study can be summarized as follows. First, the bounds test of the ARDL and NARDL specifications indicates the presence of cointegration relations among the variables. Second, according to the linear and nonlinear estimates, the significance levels and signs of the coefficients related to the conventional determinants of economic growth vary from period to period and model to model in the short run. In addition, the long-run linear and nonlinear estimates indicate that real fixed investments, the employed labor force, natural resources (except in model 4), technological development (except for negative shocks), and the educational level of the active population have a positive and statistically significant impact on economic growth. Third, the linear and nonlinear estimates robustly show that structural reforms, except for trade reforms, are positively associated with economic growth in Turkey in both the short and long run. In other words, regardless of which method is used to construct the structural reform indexes and to estimate the models, the evidence from the ARDL and NARDL model estimations reveals that financial, fiscal, real and total structural reforms have positive and statistically significant effects on economic growth. These results are consistent with those of Ormaechea *et al*. (2017), Bekaert *et al*. (2005), Aksoy (2019), Christiansen *et al*. (2013), and Ding *et al.* (2019). However, the growth potential of trade structural reforms seems not to have been realized in Turkey. The possible reason behind this result could be that trade reforms were the least implemented reforms in the country during the sample period. Therefore, it may not be useful to compare different structural reforms in terms of their effectiveness because a given reform (i.e., a trade reform) could have a strong growth effect but may be very costly to implement.

These findings point towards the fact that structural reforms may play a critical role in supporting strong and sustainable economic growth in a developing country, Turkey. Hence, along with sufficiently developing its institutions, Turkish policymakers should extend the structural reforms to lift the country's potential growth performance. While this study considered only structural reforms in four key economic sectors, a better understanding of the economic growth impact of social structural reforms, particularly in the health and education fields, may be another important question to address. In addition, since this study considers the MONA sample, there may be sample selection bias. That is, countries in MONA programs treated with reforms are precisely those with inefficient policies/outcomes. Therefore, these results may differ for other countries that are not in this sample or that have good policies/outcomes. Consistent with the findings obtained from this study, the arguments made in the theoretical and empirical literature that structural reforms can lead to economic growth by encouraging investments and job creation and improving productivity implicitly mention that structural reforms cause economic growth. However, one could easily argue the reverse case. In other words, progress in economic conditions leads to better institutions that in turn cause structural reforms. Therefore, a further study could assess the possible determinants of structural reforms (i.e., economic growth, institutional quality, macroeconomic stability, etc.) or the causal relationship between structural reforms and these possible determinants.

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Appendix

TABLE 3
NUMBER OF SUCCESSFUL REFORMS (STRUCTURAL BENCHMARKS)

Country	SB Arrange ID	Approval Year	Initial End Year	Review Type	Fiscal Reforms	Financial Reforms	Real Reforms	Trade Reforms	Total Reforms
Turkey	317	22/12/1999	21/12/2002	R10	1	2	3	0	6
	418	04/02/2002	03/02/2005	R8	1	3	2	2	8
	556	05/11/2005	05/10/2008	R7	7	11	11	0	29

Source: Authors' classification based on MONA database.

TABLE 4
DESCRIPTIVE STATISTICS

Statistics	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
RGDP	9.172	9.143	9.620	8.811	0.264	0.295	1.730
RGFI	7.683	7.667	8.379	7.064	0.463	0.121	1.491
EL	3.369	3.369	3.511	3.285	0.061	0.581	2.592
EI	0.739	0.738	0.895	0.589	0.100	0.049	1.743
NR	–1.039	–1.012	–0.357	–2.095	0.409	–0.478	3.180
RD	–0.603	–0.613	0.003	–1.608	0.465	–0.519	2.255
FNSR	0.150	0.000	1.000	0.000	0.309	2.017	5.350
FSSR	0.152	0.000	1.000	0.000	0.289	1.886	5.113
RESR	0.164	0.000	1.000	0.000	0.305	1.806	4.768
TRSR	0.133	0.000	1.000	0.000	0.346	2.157	5.653
TOSR	0.155	0.000	1.000	0.000	0.289	1.851	5.011
Observations	30	30	30	30	30	30	30

TABLE 5
UNIT ROOT TEST RESULTS

Test Statistics		ADF			PP			KSS			SLS		
Variables		**LV**	**FD**	**L**	**LV**	**FD**	**L**	**LV**	**FD**	**L**	**LV**	**FDF**	**L**
RGDP		–2.49	–4.84[a]	0	–2.57	–4.78[a]	2	–1.42	–3.67[b]	3	4.00	7.49[b]	3
RGFI		–2.64	–5.59[a]	0	–2.69	–5.66[a]	1	–1.37	–4.86[a]	1	4.10	14.57[a]	1
NR		–2.54	–5.28[a]	0	–2.48	–5.54[a]	5	–2.34	–3.70[b]	1	4.52	9.61[a]	1
RD		–3.17	–6.92[a]	0	–3.04	–10.21[a]	4	–2.96	–4.71[a]	1	4.22	14.76[a]	1
EL		–1.67	–5.32[a]	2	–1.69	–5.33[a]	2	–4.27[a]	–	4	12.32[a]	–	4
EI		–2.72	–3.91[b]	0	–2.73	–3.88[b]	0	–6.90[a]	–	2	33.13[a]	–	2
FNSR		–2.07	–5.45[a]	0	–2.21	–5.45[a]	3	–1.98	–3.65[b]	1	2.51	13.77[a]	1
FSSR		–2.05	–5.85[a]	0	–2.16	–5.88[a]	3	–1.92	–3.62[b]	1	2.66	14.25[a]	1
RESR		–2.11	–5.60[a]	0	–2.21	–5.61[a]	3	–1.90	–5.13[a]	1	2.53	12.77[a]	1
TRSR		–2.12	–5.02[a]	0	–2.21	–5.02[a]	1	–2.09	–5.20[a]	1	2.25	12.99[a]	1
TOSR		–2.05	–5.87[a]	0	–2.16	–5.90[a]	3	–1.92	–5.40[a]	1	2.67	14.02[a]	1
Critical	*%1*		**–4.30**			**–4.30**			**–3.93**			**8.79**	
Table	*%5*		**–3.57**			**–3.57**			**–3.40**			**6.54**	
Values	*%10*		**–3.22**			**–3.22**			**–3.13**			**5.41**	

Note: "a" and "b" indicate that the variables are stationary at 1% and 5% significance levels, respectively. Column "L" indicates optimal lag lengths determined by using the Schwarz Information Criterion (in the ADF, KSS, and SLS tests) and Bartlett Kernel methodology (in the PP test). The terms "FD" and "LV" indicates the first difference and level, respectively.

TABLE 6
ARDL MODEL ESTIMATION RESULTS

Panel A: Short-Run Estimates	Model-1 (2, 1, 2, 1, 0, 2, 0)		Model-2 (2, 1, 2, 1, 0, 2, 0)		Model-3 (2, 1, 2, 1, 0, 2, 0)		Model-4 (1, 0, 1, 2, 0, 2, 2)		Model-5 (2, 1, 2, 1, 0, 2, 0)	
	CE.	SE.	CE.	SE.	CE.	SE.	CE.	SE.	CE.	SE.
$RGDP_{t-1}$	-0.2902[c]	0.1586[0.090]	-0.2808	0.1682[0.119]	-0.2863	0.1627[0.102]	0.0668	0.0388[0.108]	-0.2809	0.1683[0.118]
$RGDP_{t-2}$	0.0697[b]	0.0307[0.040]	0.0735[b]	0.0328[0.043]	0.0669[c]	0.0314[0.052]	—	—	0.0728[b]	0.0328[0.045]
$RGFI_t$	0.3031[a]	0.0097[0.000]	0.3035[a]	0.0103[0.000]	0.3072[a]	0.0100[0.000]	0.2774[a]	0.0136[0.000]	0.3043[a]	0.0103[0.000]
$RGFI_{t-1}$	-0.0609	0.0421[0.172]	0.0651	0.0448[0.170]	0.0635	0.0433[0.166]	—	—	0.0655	0.0448[0.168]
EL_t	0.1318[b]	0.0445[0.010]	0.1264[b]	0.0469[0.019]	0.1331[b]	0.0458[0.012]	0.0873	0.0535[0.126]	0.1270[b]	0.0470[0.018]
EL_{t-1}	0.2987[a]	0.0438[0.000]	0.3022[a]	0.0465[0.000]	0.2889[a]	0.0452[0.000]	0.3951[a]	0.0558[0.000]	0.3001[a]	0.0465[0.000]
EL_{t-2}	0.2933[a]	0.0861[0.005]	0.2774[a]	0.0904[0.009]	0.2896[a]	0.0882[0.006]	—	—	0.2778[a]	0.0905[0.008]
EI_t	-0.6076[c]	0.2821[0.051]	-0.6001[c]	0.2995[0.066]	-0.6600[b]	0.2924[0.042]	-0.2043	0.3708[0.591]	-0.6114[c]	0.3003[0.063]
EI_{t-1}	1.4339[a]	0.2829[0.000]	1.3917[a]	0.2986[0.000]	1.4689[a]	0.2927[0.000]	0.4602	0.4795[0.355]	1.4012[a]	0.2993[0.000]
EI_{t-2}	—	—	—	—	—	—	0.4665	0.3027[0.147]	—	—
NR_t	0.0129[a]	0.0039[0.006]	0.0119[b]	0.0041[0.012]	0.0129[a]	0.0041[0.007]	0.0009	0.0047[0.840]	0.0121[b]	0.0041[0.012]
RD_t	0.0073	0.0107[0.506]	0.0076	0.0113[0.515]	0.0059	0.0109[0.595]	-0.0101	0.0149[0.511]	0.0073	0.0113[0.530]
RD_{t-1}	0.0148	0.0119[0.234]	0.0172	0.0125[0.193]	0.0161	0.0121[0.207]	0.0546[a]	0.0167[0.006]	0.0173	0.0125[0.190]
RD_{t-2}	0.0924[a]	0.0179[0.000]	0.0875[a]	0.0186[0.000]	0.0904[a]	0.0183[0.000]	0.0307[c]	0.0144[0.052]	0.0875[a]	0.0186[0.000]
SR_t	0.0089[a]	0.0019[0.000]	0.0083[a]	0.0019[0.000]	0.0084[a]	0.0018[0.001]	0.0009	0.0022[0.666]	0.0083[a]	0.0019[0.001]
SR_{t-1}	—	—	—	—	—	—	-0.0038	0.0023[0.130]	—	—
SR_{t-2}	—	—	—	—	—	—	0.0060[b]	0.0025[0.032]	—	—
C	5.4571[a]	0.6492[0.000]	5.3862[a]	0.6869[0.000]	5.4477[a]	0.6661[0.000]	5.4477[a]	0.6661[0.000]	5.3887[a]	0.6873[0.000]
Panel B: Long-Run Estimates	**CE.**	**SE.**	**CE.**	**SE.**	**CE.**	**SE.**	**CE.**	**SE.**	**CE.**	**SE.**
RGFI	0.2983[a]	0.0093[0.000]	0.3052[a]	0.0092[0.000]	0.3041[a]	0.0088[0.000]	0.2972[a]	0.0169[0.000]	0.3060[a]	0.0091[0.000]
EL	0.5931[a]	0.0349[0.000]	0.5846[a]	0.0365[0.000]	0.5837[a]	0.0344[0.000]	0.5169[a]	0.0493[0.000]	0.5834[a]	0.0363[0.000]
EI	0.6770[a]	0.0582[0.000]	0.6555[a]	0.0638[0.000]	0.6634[a]	0.0605[0.000]	0.7742[a]	0.1069[0.000]	0.6338[a]	0.0639[0.000]

Continuation Table 6

Panel A: Short-Run Estimates	Model-1 (2, 1, 2, 1, 0, 2, 0)		Model-2 (2, 1, 2, 1, 0, 2, 0)		Model-3 (2, 1, 2, 1, 0, 2, 0)		Model-4 (1, 0, 1, 2, 0, 2, 2)		Model-5 (2, 1, 2, 1, 0, 2, 0)	
	CE.	SE.	CE.	SE.	CE.	SE.	CE.	SE.	CE.	SE.
NR	0.0105[a]	0.0032[0.006]	0.0099[b]	0.0034[0.012]	0.0106[a]	0.0033[0.007]	0.0010	0.0051[0.840]	0.0099[b]	0.0034[0.011]
RD	0.0938[a]	0.0108[0.000]	0.0930[a]	0.0116[0.000]	0.0922[a]	0.0110[0.000]	0.0807[a]	0.0189[0.000]	0.0928[a]	0.0116[0.000]
SR	0.0073[a]	0.0015[0.000]	0.0069[a]	0.0016[0.000]	0.0069[a]	0.0015[0.000]	0.0033	0.0029[0.278]	0.0068[a]	0.0016[0.001]
C	4.4713[a]	0.0683[0.000]	4.4609[a]	0.0758[0.000]	4.4677[a]	0.0710[0.000]	4.6497[a]	0.1147[0.000]	4.4603[a]	0.0759[0.000]
ECM_{t-1}	-1.2205[a]	0.0933[0.000]	-1.2074[a]	0.0987[0.000]	-1.2193[a]	0.0959[0.000]	-0.9331[a]	0.0200[0.000]	-1.2082[a]	0.0988[0.000]
Panel C: Bound Test and Diagnostic Statistics										
FPSS	13.89*		12.16*		13.11*		17.36*		12.14*	
Adjusted R^2 **F**	0.99	6198.03[0.000]	0.99	5503.46[0.000]	0.99	5885.93[0.000]	0.99	3392.98[0.000]	0.99	5499.20[0.000]
RR	0.742[0.473]		0.596[0.562]		0.569[0.579]		0.129[0.899]		0.574[0.576]	
ARCH **LM**	0.019[0.888]	0.922[0.356]	0.088[0.769]	0.848[0.375]	0.001[0.972]	0.982[0.341]	0.196[0.662]	1.267[0.282]	0.074[0.787]	0.893[0.363]
JB **CS(CS^2)**	9.35[0.009]	S(S)	6.47[0.039]	S(S)	5.99[0.049]	S(S)	2.04[0.360]	S(S)	6.12[0.046]	S(S)

Note: "CE." and "SE." indicate coefficients and standard errors. "a", "b", and "c" indicate that the coefficients are statistically significant at 1%, 5%, and 10% significance levels, respectively. "t" indicates the lag order determined by Schwarz Information Criterion (SIC) while t=0. "*" indicates the presence of co-integration relationship between the variables at 1% significance level. Model-1, Model-2, Model-3, Model-4, and Model-5 respectively cover financial (FN), fiscal (FS), real (RE), trade (TR), and total (TO) structural reforms (SRs). Probabilities of the variables are given in box brackets. Model specifications (2,1,2,1,0,2,0) in models 1,2,3, and 5, and (1,0,1,2,0,2,2) in model 4 were determined by using general to specific approach and SIC with a maximum of two lags for dependent and independent variables.

TABLE 7
NARDL MODEL ESTIMATION RESULTS

Panel A: Short-Run Estimates	Model-1 (2, 2, 2, 2, 0, 1, 2, 1)		Model-2 (2, 2, 2, 2, 0, 1, 2, 1)		Model-3 (2, 2, 2, 2, 0, 1, 2, 1)		Model-4 (1, 0, 2, 1, 2, 0, 2, 0)		Model-5 (2, 2, 2, 2, 0, 1, 2, 1)	
	CE.	SE.	CE.	SE.	CE.	SE.	CE.	SE.	CE.	SE.
$RGDP_{t-1}$	-0.8105[b]	0.2627[0.018]	-0.8669[b]	0.2717[0.015]	-0.8187[b]	0.2625[0.016]	-0.0761	0.0499[0.156]	-0.8668[b]	0.2709[0.015]
$RGDP_{t-2}$	0.2852	0.1697[0.137]	0.2822	0.1707[0.142]	0.2707	0.1647[0.144]	—	—	0.2798	0.1694[0.143]
$RGFI_{t}$	0.3160[a]	0.0139[0.000]	0.3196[a]	0.0144[0.000]	0.3202[a]	0.0143[0.000]	0.3198[a]	0.0134[0.000]	0.3203[a]	0.0145[0.000]
$RGFI_{t-1}$	0.1899[b]	0.0706[0.031]	0.2094[b]	0.0726[0.024]	0.1979[b]	0.0710[0.027]	—	—	0.2103[b]	0.0726[0.023]
$RGFI_{t-2}$	-0.1027	0.0554[0.106]	-0.0985	0.0551[0.117]	-0.0961	0.0532[0.114]	—	—	-0.0975	0.0545[0.117]
EL_{t}	0.3991[a]	0.0952[0.004]	0.4318[a]	0.1029[0.004]	0.3827[a]	0.0912[0.004]	0.2057[b]	0.0717[0.015]	0.4271[a]	0.1015[0.004]
EL_{t-1}	0.3843[a]	0.0742[0.001]	0.3943[a]	0.0743[0.001]	0.3744[a]	0.0736[0.001]	0.2015[a]	0.0599[0.006]	0.3917[a]	0.0741[0.001]
EL_{t-2}	0.5234[a]	0.1334[0.005]	0.5668[a]	0.1421[0.005]	0.5086[a]	0.1309[0.006]	0.1529[c]	0.0771[0.073]	0.5622[a]	0.1409[0.005]
EI_{t}	-2.2758[a]	0.6123[0.007]	-2.5289[a]	0.6636[0.006]	-2.222[a]	0.5998[0.007]	-0.7189	0.5058[0.183]	-2.5076[a]	0.6574[0.007]
EI_{t-1}	1.6283[b]	0.5389[0.019]	1.5971[b]	0.5418[0.022]	1.6155[b]	0.5309[0.019]	1.7215[a]	0.3862[0.001]	1.5974[b]	0.5396[0.021]
EI_{t-2}	1.4111[b]	0.5591[0.039]	1.5917[b]	0.5589[0.025]	1.4214[b]	0.5553[0.038]	—	—	1.5856[b]	0.5574[0.025]
NR_{t}	0.0379[a]	0.0105[0.008]	0.0398[a]	0.0112[0.009]	0.0366[a]	0.0101[0.008]	0.0230[b]	0.0081[0.016]	0.0395[a]	0.0111[0.009]
NR_{t-1}	—	—	—	—	—	—	-0.0092	0.0058[0.144]	—	—
NR_{t-2}	—	—	—	—	—	—	-0.0132[b]	0.0055[0.037	—	—
RD^{+}_{t}	0.0816[a]	0.0206[0.006]	0.0865[a]	0.0215[0.005]	0.0815[a]	0.0205[0.005]	0.0502[b]	0.0182[0.018]	0.0863[a]	0.0215[0.005]
$RD^{+}t\text{-}1$	0.0819[b]	0.0271[0.019]	0.0911[b]	0.0278[0.014]	0.0783[b]	0.0266[0.022]	—	—	0.0899[b]	0.0276[0.014]
$RD^{+}t$	-0.1358[a]	0.0299[0.003]	-0.1406[a]	0.0308[0.003]	-0.1325[a]	0.0292[0.003]	-0.0971[a]	0.0266[0.003]	-0.1398[a]	0.0306[0.003]
$RD^{+}t\text{-}1$	-0.0859[b]	0.0499[0.013]	-0.1002	0.0531[0.101]	-0.0758	0.0485[0.162]	0.0129	0.0378[0.739]	-0.0977	0.0526[0.101]
$RD^{+}t\text{-}2$	0.1927[a]	0.0475[0.005]	0.1951[a]	0.0485[0.005]	0.1973[a]	0.0483[0.005]	0.1202[b]	0.0387[0.010]	0.1962[a]	0.0486[0.005]
SR_{t}	0.0083[a]	0.0021[0.006]	0.0078[a]	0.0020[0.006]	0.0076[a]	0.0019[0.006]	-0.0027	0.0019[0.188]	0.0077[a]	0.0020[0.006]
SR_{t-1}	0.0065[b]	0.0026[0.040]	0.0074[b]	0.0028[0.034]	0.0064[b]	0.0025[0.038]	—	—	0.0073[b]	0.0028[0.033]
C	5.7853[a]	1.1155[0.001]	5.8899[a]	1.1155[0.001]	5.9584[a]	1.0991[0.001]	4.7452[a]	0.3156[0.000]	5.9221[a]	1.1079[0.001]
Panel B: Long-Run Estimates	**CE.**	**SE.**	**CE.**	**SE.**	**CE.**	**SE.**	**CE.**	**SE.**	**CE.**	SE.
$RGFI$	0.2644[a]	0.0116[0.000]	0.2716[a]	0.0096[0.000]	0.2726[a]	0.0092[0.000]	0.2972[a]	0.0102[0.000]	0.2729[a]	0.0093[0.000]
EL	0.8567[a]	0.1157[0.000]	0.8791[a]	0.1186[0.000]	0.8176[a]	0.1031[0.000]	0.5204[a]	0.0869[0.000]	0.8702[a]	0.1156[0.000]

Continuation Table 7

Panel A: Short-Run Estimates	Model-1 (2, 2, 2, 2, 0, 1, 2, 1)		Model-2 (2, 2, 2, 2, 2, 0, 1, 2, 1)		Model-3 (2, 2, 2, 2, 2, 0, 1, 2, 1)		Model-4 (1, 0, 2, 1, 2, 0, 2, 0)		Model-5 (2, 2, 2, 2, 2, 0, 1, 2, 1)	
	CE.	SE.	CE.	SE.	CE.	SE.	CE.	SE.	CE.	SE.
EI	0.5001[b]	0.1454[0.011]	0.4164[b]	0.1547[0.031]	0.5262[a]	0.1388[0.007]	0.9316[a]	0.1900[0.000]	0.4255[b]	0.1524[0.027]
NR	0.0248[b]	0.0076[0.014]	0.0251[b]	0.0075[0.013]	0.0236[b]	0.0071[0.013]	0.0006	0.0053[0.906]	0.0246[b]	0.0074[0.012]
RD^+	0.1072[a]	0.0167[0.000]	0.1121[a]	0.0173[0.000]	0.1032[a]	0.0155[0.000]	0.0466[b]	0.0168[0.018]	0.1110[a]	0.0169[0.000]
RD^-	-0.0189	0.0292[0.536]	-0.0288	0.0292[0.355]	-0.0071	0.0278[0.805]	0.0334	0.0431[0.454]	-0.0259	0.0287[0.396]
SR	0.0096[b]	0.0028[0.011]	0.0096[b]	0.0027[0.010]	0.0091[a]	0.0026[0.009]	-0.0025	0.0017[0.172]	0.0094[a]	0.0026[0.009]
C	3.7928[a]	0.2502[0.000]	3.7169[a]	0.2626[0.000]	3.8492[a]	0.2626[0.000]	4.4094[a]	0.2213[0.000]	3.7315[a]	0.2574[0.000]
ECM_{t-1}	-1.5253[a]	0.1378[0.000]	-1.5846[a]	0.1433[0.000]	-1.5479[a]	0.1390[0.000]	-1.0761[a]	0.0226[0.000]	-1.5870[a]	0.1432[0.000]
W_{SR} W_{LR}	12.75[0.002]	11.72[0.005]	12.70[0.002]	11.69[0.006]	13.16[0.001]	11.80[0.005]	16.80[0.001]	13.22[0.001]	12.82[0.002]	11.76[0.006]
Panel C: Bound Test and Diagnostic Statistics										
FPSS	6.35*		6.34*		6.43*		14.35*		6.37*	
Adjusted R^2 **F**	0.99	5061.09[0.000]	0.99	5020.49[0.000]	0.99	5172.29[0.000]	0.99	4149.85[0.000]	0.99	5055.92[0.000]
RR	1.557[0.170]		0.946[0.380]		1.519[0.179]		0.276[0.788]		0.972[0.369]	
ARCH **LM**	0.133[0.718]	0.031[0.867]	0.722[0.404]	0.205[0.667]	0.433[0.516]	0.053[0.826]	0.058[0.812]	0.491[0.499]	0.809[0.377]	0.202[0.669]
JB **CS(CS^2)**	0.639[0.726]	S(S)	0.838[0.658]	S(S)	0.850[0.653]	S(S)	6.37[0.041]	S(S)	0.848[0.654]	**S(S)**

Note: For information on terms, symbols and models in this table, see table 6. WSR refers to the Wald test of the additive short-run symmetry condition, while WLR refers to the Wald test of long-run symmetry.

TABLE 8
EXOGENEITY WALD TEST RESULTS

Exogeneity Wald Tests			
Null Hypotheses ($H_{0:}$ Weak Exogenous)		Chi-Sq. Stat.	Prob.
RGDP	FNSR	0.006	0.941
	FSSR	4.940	0.998
	RESR	0.001	0.971
	TRSR	0.514	0.473
	TOSR	6.020	0.993
FNSR	RGDP	1.638	0.201
FSSR		1.188	0.276
RESR		1.075	0.299
TRSR		3.508	0.861
TOSR		1.102	0.293

Note: The test results obtained when the optimal lag length was (1) with the information criteria of LR, FPE, AIC, SC, and HQ for all variables.

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