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Domestic violence and women's earnings: Does frequency matter?

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Abstract

In this paper I analyse the effect of domestic violence on women's earnings, when the levels and the frequency of abuse are considered. An index for domestic violence is designed to capture the variation observed, challenging the traditional use of a dichotomous variable within this context. In addition, to conduct a causal analysis, an instrument indicating the husband's random irritability is created. Findings show that women exposed to higher levels of domestic violence, economic, emotional or physical, struggle with lower salaries. Physical violence is the type of abuse with the largest negative incidence on earnings, followed by economic and emotional violence, respectively.

Keywords: Earnings, female labor-force participation, marriage, omitted variable bias, violence against women.

JEL Classification: B54; J12

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1 Introduction

Domestic violence is a serious global challenge. Although its prevalence and incidence vary between societies, there are no countries with all the potential mechanisms set in place to fully prevent intimate partner violence[1]. One of the major concerns is how to modify social norms to eradicate women's acceptance of domestic abuse. According to the Social Institutions and Gender Index (SIGI), domestic violence (DV) is justifiable by one in three women across 108 countries (OECD, 2014). Women are at risk regardless of their country of origin, level of education, age, or labour status. In addition, estimations for Australia, Brazil, United Kingdom and Vietnam indicate an economic loss from 1% to 2% of gross domestic product due to costs associated with DV (Duvvury et al., 2012; WHO-CDC, 2008; Walby, 2004; Access Economics, 2004). Moreover, at the individual level, intimate partner violence (IPV) has severe and sometimes fatal consequences on physical and mental health, jeopardizing women's productivity in the labour market (United Nations, 2015).

This paper provides an empirical analysis of the effects of domestic violence on women's earnings, a particular area that has not yet received much attention in the literature, despite the increasing economic research focused on domestic violence. Even though some studies have examined the relationship between earnings and intimate partner violence (Vyas, 2013; Duvvury et al., 2012; Sanchez and Ribero, 2004; Morrison and Orlando, 1999), to the best of my knowledge, none of them considers a variation in the frequency of domestic violence the woman has been exposed to, as an alternative measure to IPV. Rather, most analyses are conducted comparing women who had suffered IPV at least once, against women who have never been abused. This is an understandable strategy followed by researchers given the official United Nations definition of violence against women: "any act of gender-based violence that results in, or is likely to result in, physical, sexual or psychological harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or private life"[2]. Furthermore, the incidence of IPV is not easy to track

[1] In a broader sense the term "domestic violence" can be used to indicate any type of abuse in a domestic setting, whereas the term "intimate partner violence" is only used when violence is inflicted from one spouse or partner against the other. Both terms are used indistinctively throughout this paper, referring to violence within a couple, perpetrated from a man to a woman.

[2] United Nations General Assembly. Declaration on the Elimination of Violence Against Women. In: 85th Plenary Meeting. December 20, 1993. Geneva, Switzerland; 1993.

and how to create an adequate indicator of domestic violence is an even more difficult task.

The contribution of this study is to estimate the effect of the different types of domestic violence, economic, emotional and physical; considering different levels of their frequency, on women's earnings. It also aims to provide, for the first time, empirical evidence on how a different definition of IPV can lead to very different size effects. This paper has by no means the intention to diminish the severity of domestic abuse irrespective to its frequency, so it is important to explicitly mention that intimate partner violence must be rejected at all levels. However, women trapped in a vicious cycle of abuse might be particularly susceptible to the effects of DV on their productivity, the framework this article intends to highlight. Sample selection bias and endogeneity issues are also considered.

Given the nature of the indicator of domestic violence that is suggested in this paper, a standardized variable that measures the different types of IPV only when the woman is working, the conventional Heckman model is not possible to apply. Following a methodology suggested by Wooldridge (2010) a correction is implemented to properly account for self-selection into the labour market. This technique is additionally useful when causality is addressed. Using the husband's random irritability, an instrument for domestic violence is created. The main idea is to analyse to what extent women's earnings are affected not only when they are abused, but when the abuse is unpredictable and they have no options left in order to prevent or minimize it. The analysis is conducted for Mexico using the National Survey on the Dynamics of Household Relationships (ENDIREH by its acronym in Spanish) 2016 and 2006. According to this survey 43 percent of women have experienced intimate partner violence during their current relationship, reporting emotional abuse as the most common type of violence.

Findings reveal that domestic violence reduces women's earnings, despite the IPV definition used. Physical abuse has the greatest impact of all types of violence. A one standard deviation increase in the physical violence index reduces earnings by 6.6%. Likewise, economic and emotional violence reduce earnings by 5.3% and 4.7% respectively. If the "traditional" measure of DV is adopted (any form of abuse), the results show that women with at least one incident of physical violence earn on average 22.4% less than women never abused. Using this same definition, earnings also decrease by 16.4% for economic violence and 14.5% for emotional violence. Although the estimations obtained from these two different approaches are not directly comparable,

calculations for a hypothetical case reveal that earnings are reduced in 46.9 percent for a woman facing the highest level of physical abuse when using the index for IPV instead of the traditional measure of DV.

The rest of the article is organised as follows: Section 2 presents the literature review. An overview of the context of women in Mexico is provided in Section 3. The estimation strategy is discussed in Section 4. In Section 5 the data used is described and Section 6 presents the estimation results. Conclusion is set out in Section 7.

2 Literature review – Measures of domestic violence

From a theoretical perspective, despite the ambiguous effect that domestic violence exerts on women's labour force participation (Lloyd, 1997; Morrison and Orlando, 1999; Farmer and Tiefenthaler, 2004; Crowne et al., 2011), the mechanism through which DV affects earnings is very straightforward. Women suffering intimate partner violence are more likely to experience depression, substance abuse, female reproductive disorders, sexually transmitted infections, low back pain, headaches, gastroesophageal reflux disease, amongst others (Anderson et al., 2003; Martin et al., 2008, Bonomi et al., 2009); conditions that seriously compromise job performance for those in the labour market.

Very few empirical studies have analysed the relationship between earnings and domestic violence. One of the earliest papers analyses two Latin American countries, Chile and Nicaragua (Morrison and Orlando, 1999). The paper classifies IPV into four different types: moderate and severe physical violence, as well as psychological and sexual abuse[3]. The indicator for DV is equal to one if the woman has experienced any type of domestic abuse, or zero otherwise. Regression estimates indicate that domestic abuse is significantly related to lower women's monthly earnings. Abused women in Chile and Nicaragua earn on average 34% and 46% less, respectively, than women who have never been exposed to IPV[4]. One of the main limitations in the analysis is the sample

[3] Moderate physical violence, fewer than five acts of moderate physical violence in last year. Severe physical violence, more than five acts of moderate physical violence or any act of severe physical violence in a year. Psychological violence, insults or threats more than five times a year. Sexual violence, any type of coercion to force a woman to have sex.

[4] Results for Nicaragua include a correction for selection bias. The authors indicate that the earnings equation results reported for Chile does not include this term given its lack of significance. In addition, to address reverse causality between earnings and IPV, simultaneous equations models for earnings and

size. Surveys were conducted just in two cities, Santiago in Chile and Managua in Nicaragua, and the earnings equations were estimated using only 106 observations for Chile and 121 observations for Nicaragua. Morrison and Orlando (1999) also indicate that results using the different types of domestic violence separately show a negative and significant effect on earnings, but the article does not provide any additional information so it is not possible to identify the type of violence with the strongest negative impact on earnings.

In a more recent analysis, using data from Tanzania, Propensity Score Matching (PSM) methods are implemented to identify the effects of partner violence on earnings for women working in formal waged work and non-agricultural self-employment (Vyas, 2013). Four measures of DV are established: Lifetime physical and/or sexual violence; lifetime physical (severe) and/or sexual violence; current physical and/or sexual violence (past 12 months); and current physical (severe) and/or sexual violence (past 12 months). The domestic violence measure takes the value of one if the woman reported having experienced any act that fits into the definition[5]. General findings show lower earnings for abused women when compared to women never exposed to IPV. Most extreme differences are for women that have experienced current physical (severe) and/or sexual violence (total sample) with 47% to 53% lower earnings, and for women in formal waged work that have experienced physical (severe) and/or sexual violence (current and lifetime) with 57% to 61% less earnings. Vyas (2013) indicates that the largest female employment sector in Tanzania is agricultural self-employment, but it was not included in the analysis because data was not available. It is also mentioned that the use of PSM attempts to reduce the potential bias in the non-randomness of partner violence, but inferring a causal relationship might be difficult given the unobserved heterogeneity not addressed in the analysis.

Given the inherent difficulties in most of the analyses conducted when trying to disentangle all the potential sources of heterogeneity, the true effects between any type of violence against women (VAW) and earnings are not easy to determine. Sabia et al. (2013) is the only formal economic paper, to the best of my knowledge, that strongly controls for a wide range of community, school, family and individual levels of heterogeneity in a related context. Although the article does not address intimate partner

violence are performed. However, estimations indicate that women's earnings are not a determinant of domestic violence.

[5] Lifetime measure excludes abuse in the last 12 months.

violence but sexual assault, it is found that hourly wages for young adult women who reported sexual violence are 5.1 percent lower compared to earnings from women never sexually abused.

For the particular case of Mexico, no previous studies have directly analysed the relationship between domestic violence and earnings. An inspiring paper by Bobonis et al. (2013), discusses the effects on domestic violence of conditional cash transfers to beneficiary women enrolled in the Mexican Oportunidades program[6], compared to non-beneficiary women. IPV is categorised as physical, sexual or emotional abuse. A dichotomous variable for each measure of DV takes the value of one if the female has suffered that type of violence in the past 12 months. Results reveal that beneficiary women are less likely to experience physical abuse as an improvement in their bargaining power, but they are also more likely to suffer emotional violence, possibly as an alternative used by male partners to reposition themselves as the dominant figure within the household.

Domestic violence analyses are typically conducted using as a measure of IPV an indicator with only two options, abused or not abused. Erten and Keskin (2018) provide an interesting different approach in order to determine the causal effect of education on domestic violence in Turkey, exploiting a change in compulsory education. Based on a full set of questions related to DV, a binary variable is created for each question. If the woman has ever suffered that particular act of abuse from her partner, it takes the value of one, or zero if she has never been exposed to it. Later, the z-scores per question are obtained and grouped into four categories: physical, sexual, psychological or economic violence, according to the type of violence they assess. Finally, for each category the average of the z-scores is calculated and used to create the four indices of IPV. Evidence confirms adverse impacts by the educational reform on psychological and economic violence and no effects on physical and sexual abuse, for women in rural areas. Even though the DV index does not capture different levels of violence inflicted, it is a remarkable introduction to the traditional measures of domestic violence used in the literature. It also provides the basis for the IPV indicator proposed in this paper, further explained in Section 4.

[6] Oportunidades used to be the main anti-poverty government social program in the country.

3 Mexican women – A contextual approach

According to the 2010 census of Mexico, 112 million people live in the country. Women account for 51.2 percent of the population, holding a slight lead over men. The average years of schooling for women are 8.5[7]. Efforts continue under way to eradicate illiteracy with 8.1 percent of women remaining illiterate. Fertility rate has declined to 1.7 children per woman, compared to 2.4 in 1990[8]. Considering the level of education, women with no more than compulsory school (9 years) bear on average 2.7 children, while women with higher levels of education have only 1.1. Among women aged 15 years or older, 42.6 percent are married, 27.5 percent are single, 15.1 percent cohabitate and 14.6 percent are either separated, divorced or widow[9].

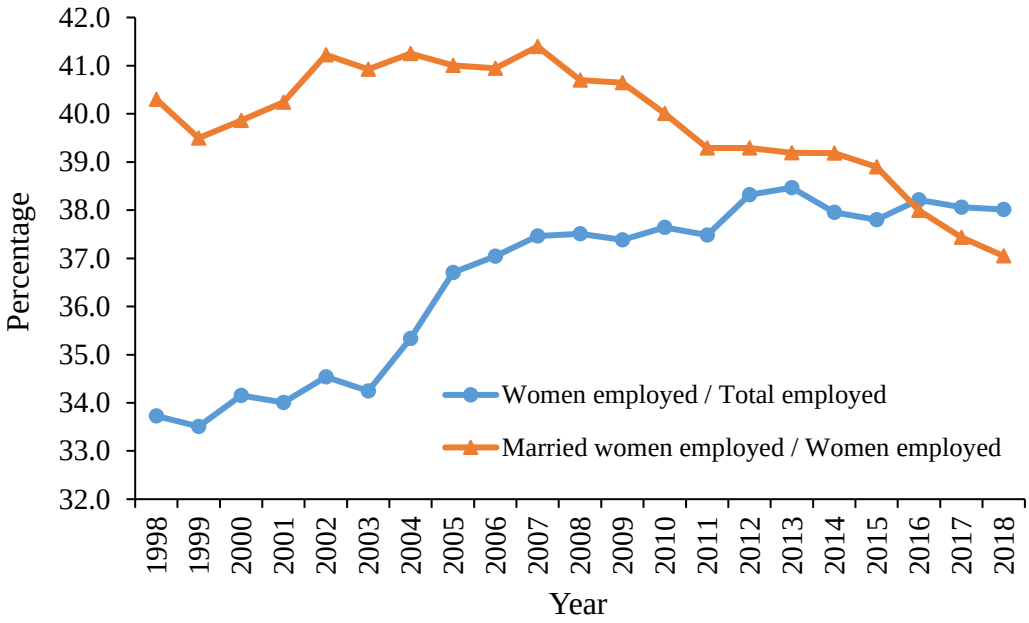
3.1 Women at work

Over the last 20 years a gradual increase in women's working patterns has been observed in Mexico. In 2018 women represented 38 percent of the total employed population, compared to 33.7 percent in 1998. However, the proportion of employed married women has declined from 40 percent in 1998 to 37 percent in 2018, when only considering employed women (see Figure 1). This fall has been partially compensated by a continuous rise in the proportion of cohabiting women employed, 6.4 percent in 1998 and 14.9 percent in 2018[10]. The current unemployment rate in Mexico is around 3.2 percent. Women represent about 40% of the unemployed population, a percentage that has remained relatively stable since 1998, with 671 226 unemployed women during the first trimester of 2018 (see Figure 2). Data by sectoral participation indicates that women are mostly engaged in the tertiary sector (services), the prevailing sector in the Mexican economy, representing almost 50 percent of the employed population in 2018. On the contrary, women's participation in the primary sector (agriculture) and the secondary sector (industry), has not only steadily decreased but is much less than half of men (see

[7] Women aged 15 years or older.
[8] Women aged between 15 to 49 years old. Average number of children born alive.
[9] Percentages do not add up to 100 because 0.2 percent of women did not report their marital status.
[10] National Employment Survey (ENE) for 1998 and National Survey of Occupation and Employment (ENOE) for 2018.

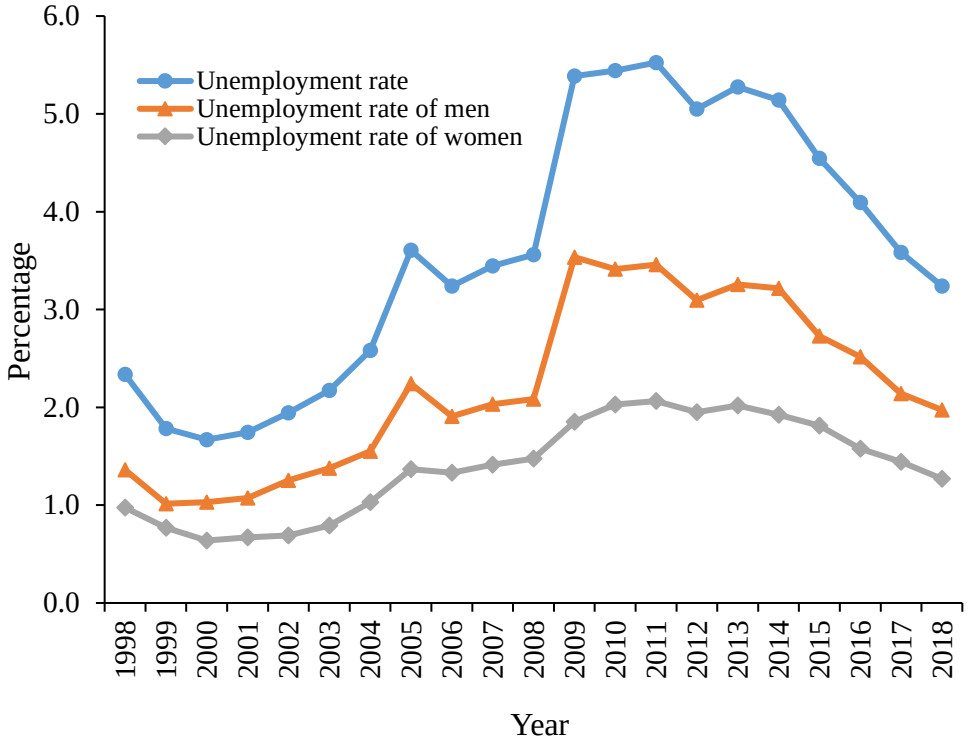
Figure 3). Not surprisingly, women comprise the majority of the economically inactive population. For the period 2005-2018, on average, 75 percent of the working-age population not in the labour force were females. Besides, among females, married women lead this trend with 12.1 million out of the labour market in 2018 (see Figure 4). While these data provide a very general overview on the evolution of women's labour force participation in Mexico, there are no striking features indicating a radical change on female labour supply during the past two decades.

Figure 1 Women and employment



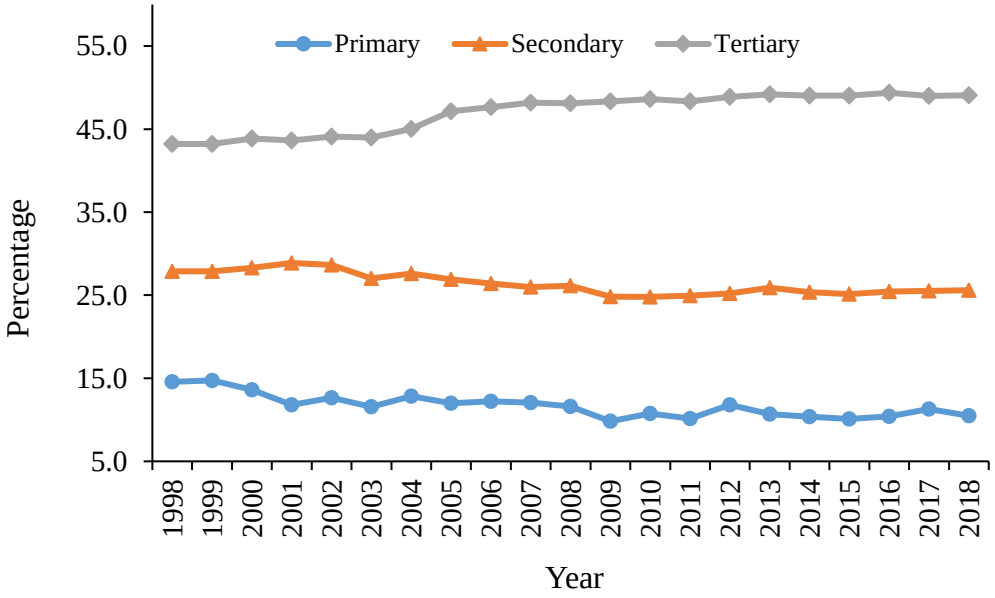
Source: National Institute of Statistics and Geography (INEGI). National Survey of Occupation and Employment (ENOE) for 2005 to 2018. National Employment Survey (ENE) for 1998 to 2004. Second trimester reported. ENE was replaced by ENOE in 2005, so they are not strictly comparable.

Figure 2 Unemployment rates



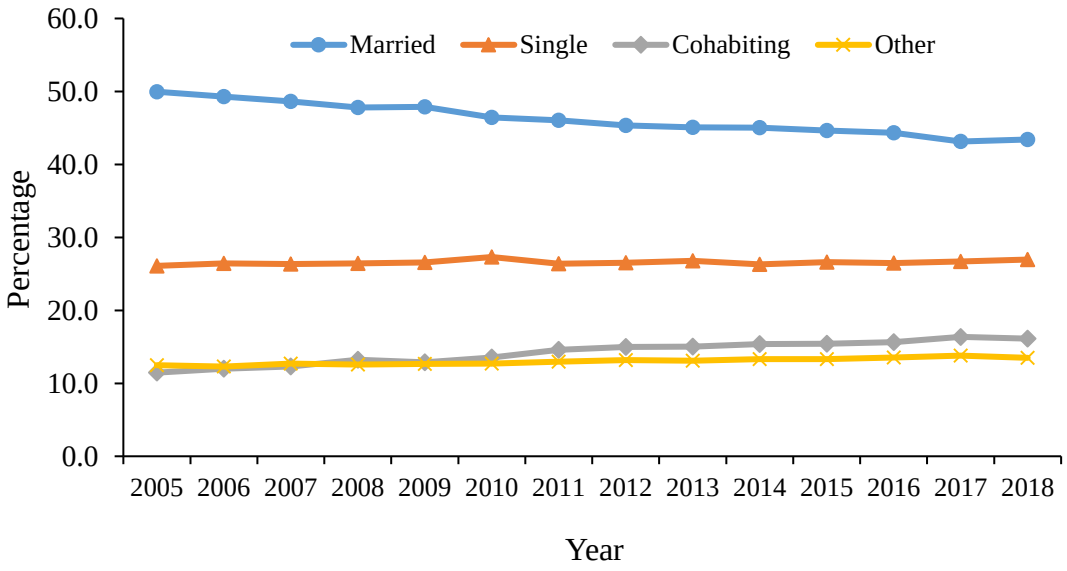
Source: National Institute of Statistics and Geography (INEGI). National Survey of Occupation and Employment (ENOE) for 2005 to 2018. National Employment Survey (ENE) for 1998 to 2004. Second trimester reported. ENE was replaced by ENOE in 2005, so they are not strictly comparable.

Figure 3 Sectorial participation of women



Source: National Institute of Statistics and Geography (INEGI). National Survey of Occupation and Employment (ENOE) for 2005 to 2018. National Employment Survey (ENE) for 1998 to 2004. Second trimester reported. ENE was replaced by ENOE in 2005, so they are not strictly comparable.

Figure 4 Women out of the labour force



Source: National Institute of Statistics and Geography (INEGI). National Survey of Occupation and Employment (ENOE). Second trimester reported. Category "Other" includes marital status divorced, separated, widow and not specified.

In fact, Mexican female labour market participation is below the average for OECD countries with the second-lowest rate only after Turkey. Barriers for females to join and remain in the workforce in Mexico are several. In addition to low salaries, long commutes and an employment legislation that could be improved in terms of gender and parenting; employees in Mexico are expected to work at least ten hours daily (regardless of the cap of 8 hours established in most workplaces), around 60% of the population believe that female breadwinners pose a threat to household stability, a lack of adequate supply of childcare for young children exists and rates of violence against women continue to be alarming (OECD, 2017). All these factors represent additional difficulties for women to participate in the labour force. The next section provides information on gender-based violence to present a summarized outline about its prevalence in Mexico.

3.2 Gender-based violence in Mexico

On average, 7.5 women were killed every day in Mexico in 2016. Since 2011, femicide rates have been at their highest levels, with 4.6 women murdered for every 100 000 women in 2011 and 2012, against 1.9 in 2007, the lowest rate recorded over the last 30 years. For the period 2012-2016, a rise in the number of women murdered between 20

and 40 years old, specifically during women's reproductive age, reveals an important change in the structure of women's homicides and might be considered an indicator of the increasing levels of intimate partner violence suffered by women (Echarri, 2017). Moreover, by comparing estimations for female homicides per 100 000 women in 2016 for five different countries, the vulnerable situation that Mexican women face is evident (see Table 1).

Table 1 Women killed by 100 000 women in 2016

Country	Rate
1. Colombia	4.1
2. Mexico	***4.4***
3. Peru	3.3
4. United States	1.9
5. United Kingdom	0.6

Source: Author's own calculations for Colombia - Departamento Administrativo Nacional de Estadistica (DANE); Peru - Instituto Nacional de Estadistica e Informatica (INEI); United States – STATISTA; and United Kingdom - Office for National Statistics (ONS). Data for Mexico from Echarri, 2017.

Although a partner should be someone to rely upon and trust, women are more likely to suffer violence from intimate partners/family, than by any other type of perpetrators. Global data indicates that almost 50 percent of all women murdered in 2012 died at hands of their partners or family, but less than 6 percent of men were killed under these circumstances (UNODC 2013).

Data for Mexico shows that around 45 percent of women that have been in a relationship between 2006 and 2016 have experienced intimate partner violence[11]. Furthermore, 78.6 percent of Mexican women that suffered physical or sexual abuse from partners never reported the incident[12]. While 28.8 percent of these women suggested the violent episode was not relevant enough to be disclosed, many others did not come forward because they were afraid, ashamed, did not know how and where to file the complaint, or do not trust the authorities, to mention some of the most important reasons. On top of that, 35 percent of these women reported having suffered physical damage, mainly in the form of bruises or inflammation, but also as haemorrhages, bleeding, burns, lost teeth, fractures, amongst others[13].

[11] National Surveys on the Dynamics of Household Relationships (ENDIREH). 2006, 2011 and 2016.
[12] National Survey on the Dynamics of Household Relationships 2016 (ENDIREH).
[13] National Survey on the Dynamics of Household Relationships 2016 (ENDIREH).

There has been a growing recognition of the importance of gender-based violence in Mexico. Two efforts are worth highlighting. In 2007, the General Law on Women's Access to a Life Free of Violence was published[14]. Its aim is to prevent, to punish and to eradicate violence against women. Six types of violence are identified: psychological, physical, violence against property, economic, sexual, and violence against the woman's dignity, integrity or freedom. A number of modifications have been continuously implemented to this law in order to have a better tool to combat gender-based violence. Secondly, since 2003 the National Institute of Statistics and Geography (INEGI) has carried out the National Survey on the Dynamics of Household Relationships (ENDIREH) to collect information on emotional, physical, patrimonial, economic and sexual violence that Mexican women experience with intimate partners, within the family, at work, at school or in their communities. There have been four cross-sectional surveys conducted in 2003, 2006, 2011 and 2016. This initiative has helped to generate statistics and indicators on VAW, and more importantly, to raise awareness of its magnitude in the country. However, while there has been some progress on violence and gender issues, much remains to be done.

Mexico ranks 81st in the Global Gender Gap Index (only above Brazil, Paraguay and Guatemala from the Latin America region), and the position drops to 124th when considering the Economic Participation and Opportunity subindex (WEF 2017). Efforts need to continue to reduce discrimination against women at all levels, in terms of justice, security, employment, health, education and social protection. Challenging tasks are to improve women's current conditions and to modify attitudes towards them at very young ages, at school and at home; otherwise women will continue to be trapped in a cycle of violence that is affecting not only women, but the Mexican society as a whole (OECD 2017).

4 Estimation strategy

The human capital earnings function can be considered one of the most popular benchmark models in applied econometrics to study the relationship between earnings and education, but it certainly has been widely used to analyse the influence of many

[14] Official Journal of the Federation. February 1st, 2007.

others factors on earnings as well. To examine the effect of domestic violence on women's earnings the following variation of the Mincer equation (Mincer, 1974) is considered as the baseline regression in this paper:

$$LnW_i = \beta_{Ed}Ed_i + \beta_{Ex}Ex_i + \beta_{Ex^2}Ex_i^2 + \beta_{Ar}Ar_i + \beta_{Et}Et_i + \beta_{Ch}Ch_i + \beta_{Ye}Ye_i + \beta_{Dv}Dv_i + \varepsilon_i \quad (1)$$

Where the subscript i refers to women and $i = 1, \dots, n$; LnW_i is the natural logarithm of earnings, Ed_i is the number of years of schooling, and Ex_i and Ex_i^2 are the potential years of labour market experience and its square. In addition, four binary variables denoting if the woman i lives in an urban area $Ar_i = 1$, belongs to an ethnic group $Et_i = 1$, has at least one child $Ch_i = 1$, and belongs to ENDIREH 2006 $Ye_i = 1$; or zero otherwise, are included. Finally, Dv_i is the indicator of domestic violence.

4.1 An index for domestic violence

As explained earlier, domestic violence is complex to measure. Even if underreporting is ignored given the reluctance of the victims to report the abuse, or extensive efforts are addressed to accurately count all the incidents, it is difficult to differentiate in terms of units the level of abuse a husband that kicks his wife once per week is inflicting on her, compared to a husband that chokes his wife "only" every two months. This can be an additional argument supporting the most commonly strategy used when trying to measure domestic violence, any act of abuse experienced identifies the woman as abused. On the contrary, it can be argued that the level of domestic violence a woman has faced because her partner pushed her or pulled her hair one time is definitively not the same as the IPV suffered by a woman from a partner slapping her daily.

As one of the contributions of this paper, an indicator capturing variation in the levels of domestic violence is presented. It is not expected to be perfect, but it is an interesting initial effort to introduce and highlight how relevant it is to consider the frequency of domestic abuse. Hopefully it will challenge the traditional use of a dichotomous variable in the literature on DV and will also stimulate researchers to develop more precise measures of intimate partner violence.

DV is classified in three different types: economic, emotional and physical, according to the set of questions designed in the survey to identify each category of violence[15]. All questions have at least three possible outcomes to determine the regularity of that particular act of abuse the woman has experienced in the last 12 months from her intimate partner: more than once, only once or never[16]. One variable is created for every question. If the woman has never been abused, the variable takes the value of 0; if she has suffered that abuse one time, then the value of the variable is 1; and if she has been abused more than once, the variable takes the value of 2.

Once a variable with three levels (0, 1 or 2) is generated for all questions, the next step is to obtain the frequency of the abuse by adding up the different levels by question within each type of domestic violence. Given that the number of questions by category varies, for example, there are 13 questions to identify emotional abuse and six questions related to economic abuse, then, emotional violence can reach 26 points as a maximum, whereas economic violence can go up to 12 points. To adjust for the differences in the number of questions per type of IPV, the final index is calculated from standardizing the frequency of abuse for each dimension of violence. As a result, three indices are constructed: economic violence index, emotional violence index and physical violence index. All of them with a mean of zero and a standard deviation of one. This approach allows us to analyse the effect that one standard deviation increase (or decrease) in any of the indices on domestic violence has on earnings, considering at the same time the levels and frequencies of the abuse, and not only identifying if the woman has experienced any act of violence in that particular dimension.

[15] Survey interview questions grouped by dimension of domestic violence are presented in Table 12 in the Appendix. There are some differences between the questions asked in ENDIREH 2006 and ENDIREH 2016. Efforts were addressed to match both surveys.

[16] ENDIREH 2016 has not only three but four different categories to determine the level of abuse: very often, a few times, only once or never. A difficulty arises when trying to record "very often" and "few times". While the difference from never abused to abused once is very straightforward, just one jump in the unit of measurement, it is not specified if few times is less than ten times or five times; or if very often is more than five times or ten times, for instance. Thus, the breaking point between "very often" and "few times" is not clear, and self-perception of the woman plays an even more important role. Whereas some women could have reported ten times as few times, others could have reported it as very often. To overcome this challenge, the decision taken is to merge both categories into one, because what is known for sure is that few times and very often is more than one time. So the variable takes the value of 2 if the woman has reported very often or few times in ENDIREH 2016, indicating a woman that has experienced that kind of abuse on two or more occasions, which is in line to the options available for ENDIREH 2006.

4.2 Sample selection bias – Working against non-working married women

In this paper the analysis is centred on married women and the impact of domestic violence on their earnings. As mentioned earlier, women's participation rate in the Mexican labour market is not massive, so self-selection bias in the nature of the analysis conducted is highly likely to be present. Women who join the workforce might have characteristics that systematically differentiate them from non-working females. Not to consider that the earnings for non-working women are not included in the analysis can be problematic when trying to establish inferences about the relationship between domestic violence and married women's earnings as a whole.

The method most widely used to correct for sample selection bias is a two-step procedure proposed by Heckman (1976), also known as the Heckit model. In broad terms, the estimation comprises in the first stage a selection equation that determines the probability of participation in the labour force, and as the second step an outcome equation to estimate the wage offer conditional on the woman joining the labour market.

Based on the indices of domestic violence defined previously, the Heckit model cannot be applied directly here. The z-scores calculated through the standardization process are only obtained using the subsample of working females, so the measurements of abuse are not available for non-working women and the traditional Heckit estimation cannot take place because now one of the explanatory variables (the most relevant) is also truncated[17]. Later on, in the identification strategy section, the details on how to perform the estimations using as a baseline the Heckman model are presented.

4.3 Claiming causality

A problem when trying to establish a causal effect is to prove that variable A, in our case domestic violence, is beyond reasonable doubt a factor affecting variable B, women's earnings. If a direct link between these two variables cannot be established, then

[17] If the z-scores are obtained using both groups, working and non-working females, then, when trying to estimate the impact of each type of domestic abuse on earnings, the indices of violence will not comply with the characteristics of a standardized variable, a mean of zero and a standard deviation of one. It is important to distinguish that the adjustment done for the sample selection bias through the selection equation is to obtain unbiased estimators to make more accurate inferences about the population, but the estimation of the outcome equation incorporating the correction is only performed on the subsample of working women.

uncertainty about other possible variables affecting earnings through domestic abuse cannot be discarded, and causality would be far from being claimed. For instance, it can be argued that alcoholic husbands are more likely to abuse their wives, so a real root cause for lower earnings among married women may be to have a partner that drinks heavily and not domestic violence per se.

A technique successfully employed in economics to overcome the endogeneity problem is the method of instrumental variables. The key element is to find a valid instrument meeting three main requirements. The instrument must have a causal effect on the variable whose effects are trying to be captured, in this case domestic violence. It should be also unrelated to the omitted variables that would be ideal to control for, as an alcoholic husband for example. Lastly, the instrument has to affect the outcome, earnings, only through a single channel, domestic abuse, and not through other explanatory variables like the years of schooling or if the woman belongs to an ethnic group (Angrist and Pischke, 2015).

In some cases, it can be remarkably difficult to find an instrument satisfying these conditions. The domestic abuse variable is not easy to tackle. Many factors potentially triggering the levels of domestic violence, such as having witnessed domestic abuse between parents or to have been victim of violence during childhood, fertility issues, a large age gap within the couple or financial problems, just to name a few, can also simultaneously affect the ability of the woman to earn money through other mechanisms, which invalidates their use as possible instruments.

To conduct a causal analysis in this paper, an instrument indicating the husband's random irritability is created. ENDIREH, the survey used, devotes a specific section where women are asked if their partners get angry with them under certain conditions. There are several questions, and the causes of anger are diverse, exploring if the husband gets upset with his wife because she uses contraceptives, he believes she has an affair, she fails to fulfill the agreements established, and so forth.

One of the questions is: "Does your husband or partner gets angry with you for everything or for no reason?" This is a very useful question when trying to find an instrument for domestic violence. While women report several other reasons they are aware irritate their partners, for this question in particular there is nothing they can actually do to avoid an episode of anger from them. If the wife knows that not to obey her husband is going to cause trouble, then she has two options, either not to disobey him at all, or be prepared in advance to deal with the coming conflict. Unfortunately, when the

woman indicates her partner gets irritated for everything or for no reason, it means for example that if she talks he gets mad, but if she does not talk he also becomes hostile; if she leaves him alone he is displeased, and if she is with him all the time he is annoyed as well. In these situations the woman is left with no options to prevent the domestic abuse and the husband's inexplicable irritability can be considered randomly assigned because it is completely independent from specific factors or situations. In addition, the question explicitly indicates the partner's anger should be directed to the woman (gets angry with you), so it is sensible to assume a direct link existing between the husband's random irritability and the domestic abuse; assuming the existence of a first stage. An upset partner will necessarily manifest his irritation through an act of violence, any act, otherwise, there would not be a visible indication perceived by the woman about her partner's current anger condition. It is worth highlighting that the husband's random irritability can be used as an instrument for any of the types of domestic violence, economic, emotional and physical. Some partners stop talking to women to demonstrate irritation, others can hit them or restrict the access to money. Random aggressiveness includes a wide range of non-predetermined behaviours allowing its use as an instrument for all the categories of domestic abuse. The last criteria to verify in order to have a possible valid instrument is if the husband's random irritability has an effect on earnings only through domestic violence. Due to the inherent nature of the instrument suggested, an unexplained rush of anger, it is challenging to think in other mechanisms different to domestic abuse affected by the instrument and impacting women's earnings as a result. Women do not know the source of this unexpected irritation, but they do know for instance, it is not explained because they work or study, so there are no incentives to modify their working status or their level of education; satisfying the exclusion restriction.

The instrument chosen determines the subpopulation affected, as a consequence, the group's particular characteristics are important to consider when trying to determine the true causal effect. Using the husband's random irritability as the instrument for domestic violence indicates the women affected by the instrument are more likely to live in a constant state of alertness, they know a sudden boost of irritation can come from nowhere. Hence, the impact of domestic violence on earnings is expected to be downward biased, given that the instrument is affecting women that are even more vulnerable to the magnitudes of domestic violence.

Causal inference using instrumental variables (IV) is fairly well known, but IV estimators cannot be completely reliable when there are concerns about the presence of sample selection bias, as previously stated in this analysis, so the final approach adopted in this paper is described next.

4.4 Identification strategy

There are two issues preventing the use of conventional econometric tools to deal with sample selection bias and endogeneity. The standardized indices created to measure the different types of domestic violence cannot be used to implement the Heckman model in order to correct for sample selection bias because they are truncated. Additionally, the process involved in the IV estimation is not originally designed to address sample selection bias in a direct manner. Wooldrige (2010) suggests a method to obtain unbiased estimators in a similar context.

Adapting Wooldrige (2010:809) to the model described in Equation (1):

$$LnW_i = \alpha_{Ed}Ed_i + \alpha_{Ex}Ex_i + \alpha_{Ex^2}Ex_i^2 + \alpha_{Ar}Ar_i + \alpha_{Et}Et_i + \alpha_{Ch}Ch_i + \alpha_{Ye}Ye_i + \alpha_{\widehat{Im}}\widehat{Im_\iota} + \alpha_{\widehat{Dv}}\widehat{Dv_\iota} + u_i \quad (2)$$

$$Dv_i = \gamma_{Ed}Ed_i + \gamma_{Ex}Ex_i + \gamma_{Ex^2}Ex_i^2 + \gamma_{Ar}Ar_i + \gamma_{Et}Et_i + \gamma_{Ch}Ch_i + \gamma_{Ye}Ye_i + \gamma_{\widehat{Im}}\widehat{Im_\iota} + \gamma_{In}In_i + v_i \quad (3)$$

$$Em_i = \delta_{Ed}Ed_i + \delta_{Ex}Ex_i + \delta_{Ex^2}Ex_i^2 + \delta_{Ar}Ar_i + \delta_{Et}Et_i + \delta_{Ch}Ch_i + \delta_{Ye}Ye_i + \delta_{Ga}Ga_i + \delta_{In}In_i + \mu_i \quad (4)$$

Where (2) is the structural equation of interest, (3) is the linear projection for the endogenous variable Dv and (4) is the selection equation.

Most variables denoted in Equations (2), (3), and (4) were initially defined in Equation (1). LnW_i represents log of earnings, Ed_i years of schooling, Ex_i and Ex_i^2 potential experience and its square, Ar_i area where the woman lives, Et_i ethnic group, Ch_i at least one child, Ye_i year of the survey, and Dv_i domestic violence. There are five new

variables: $\widehat{Im_i}$ denotes the inverse Mills ratio obtained, $\widehat{Dv_i}$ the level of domestic violence estimated, In_i is the instrument, Em_i is a binary variable equal to 1 if the woman i is employed or zero otherwise, and Ga_i is the gender attitudes index.

The inverse Mills ratio (IMR) and the level of domestic violence estimated are obtained as part of the process, as will be explained further. The instrument represents the husband's random irritability and takes the value of 1 if the husband gets angry with his wife for everything or for no reason, or zero otherwise. The gender attitudes index is created using the answers women provided on six different questions about the roles in the household, such as if they believe that women should be equally responsible as men as financial providers; or if they believe that good wives should always obey their husbands[18]. The highest possible score is 6 and the lowest is 0. The closer to 6, the index indicates a woman with more egalitarian attitudes towards gender roles; the closer to 0 shows a woman with more "traditional" views. The gender index is the factor affecting selection, the decision to join or not the labour market; thus, as can be observed, this variable is only used in the selection equation (4), explaining the probability of employment, but not the equation of interest, the earnings equation (2). As it is sometimes hard to come up with a variable affecting selection and not the outcome, technically, it is possible to estimate Equation (3) and Equation (4) using the same regressors. However, not to include the variable determining selection in Equation (4), would generate collinearity because the variables used to estimate Equation (4) and to obtain the inverse Mills ratio (IMR) from Equation (3) would be the same. The gender attitudes index created is a primarily force driving the decision about joining or not the labour force with a minimal influence on women's earnings[19]. After all, the hardest choice is whether or not to modify the traditional family structure, but once the woman is determined to join the labour force, she expects a financial reward according to the time and effort devoted to work[20].

The estimation procedure is implemented as follows:

- First, Equation (4) is estimated using a probit model on all observations, working and non-working married women, to obtain the predicted inverse Mills

[18] Different questions were asked in ENDIREH 2006 and ENDIREH 2016. Efforts were addressed to match both surveys. Table 13 in the Appendix section, details the questions used to create the gender attitudes index.

[19] Especially since the indicator is built based on different questions and not only on a single one.

[20] It could be argued that some of the questions are directly linked with the labour market, having a potential influence on earnings. To dispel any concern, additional robustness checks are performed using different definitions of the gender attitudes index, not including all the six questions.

ratios $\widehat{Im}_i$. The IMR is the ratio of the probability density function over the cumulative distribution function of a distribution. In this case, it shows the probability that a woman decides to work over the cumulative probability of a woman's decision and it is used to control the part of the error term influencing earnings given the decision to work.

- By using two-stage least squares (2SLS), Equations (2) and (3) are estimated on the subsample of working women, after including the IMR as an additional explanatory variable, and the husband's random irritability defined as the instrument for domestic violence.
- Finally, it should be verified that the IMR coefficient obtained in Equation (2) is statistically different from zero ($\alpha_{\widehat{Im}} \neq 0$) as evidence of sample selection, and to correct the standard errors and test statistics by bootstrapping.

5 Data

The analysis is based on the National Survey on the Dynamics of Household Relationships (ENDIREH by its acronym in Spanish) 2016 and 2006. ENDIREH has been strategically designed to obtain information about the frequency and magnitude of violence experienced by women within the household, as well as to identify events of discrimination, aggression and violence at school, at work, or in their families and communities. It is a cross-sectional national survey of women aged 15 and over in Mexico, led by the National Institute of Statistics and Geography (INEGI). The first survey was conducted in 2003, and subsequently in 2006, 2011 and 2016. Each delivery has been improved in terms of the conceptual framework and the questionnaires used to collect the information. In the 2016 survey, data is available for 111 256 women, whereas 133 398 women were interviewed in 2006[21].

To study the effect of domestic violence on women's earnings, the target subpopulation are married women currently living with their husbands[22]. The group of

[21] ENDIREH 2003 and 2011 are excluded from this analysis because the question used to create the instrument for domestic violence under the instrumental variables methodology is not available for those years.

[22] Married women with absent husbands are not considered. In addition, civil marriages are the only ones legally recognized in Mexico, therefore, women in the sample are only those with a civil marriage or a civil

cohabiting women is excluded because it might be easier for them to leave an abusive partner or even to prevent abuse, compared to women in legally binding relationships.

ENDIREH is the only survey with national representative data about gender-based violence in Mexico, but a compromise needs to be done with the study to use it. Even though the survey provides information about total net weekly, fortnightly or monthly earnings, the total amount of hours worked is unknown, restricting the dependent variable to be monthly earnings instead of hourly earnings. While this could be considered a disadvantage in studies for developed countries where minimum wages are usually set on an hourly basis, for the case of Mexico, with a minimum wage established at 73.04 Mexican pesos per 8-hour workday in 2016[23], it might be less of a problem. Thus, it is important to highlight that this paper identifies the effect of domestic violence on monthly earnings reported by women. Based on this, earnings are bottom-coded at 2 200 Mexican pesos per month[24], and the final sample consists of 27 823 married working women and 64 060 married non-working women aged 22 to 60[25]. Tables 2, 3 and 4 show some summary statistics. As expected, on average working women accumulate more years of education and report more egalitarian views than do non-working women. Considering only the subsample of working women, it is observed that never abused women have slightly higher levels of education and age. In addition, around 35 percent of working women have experienced at least one episode of IPV, being emotional violence the category of abuse with the highest incidence.

Table 1 Summary statistics – Mean and standard deviation values for married women

Variable	Working women		Non-working women	
	Mean	Standard deviation	Mean	Standard deviation
Years of schooling	11.6	4.5	8.3	4.3
Age	39.3	8.8	40.7	10.3
Gender attitudes index	4.9	1.0	4.3	1.3
Total	**27 823**		**64 060**	

Source: Author's own elaboration with data from the National Survey on the Dynamics of Household Relationships 2016 (ENDIREH).

marriage and a religious marriage. Women married only through a religious ceremony were not included either.

[23] Official Journal of the Federation. December 18th, 2015. In terms of pounds sterling in 2016, the Mexican daily minimum wage represents around £3.

[24] Real wages. Base year 2016.

[25] University degrees are obtained around 22 years old, and employees are entitled to start receiving pension benefits at age 60.

Table 2 Summary statistics – Mean and standard deviation values for married working women

Variable	Abused women		Never abused women	
	Mean	Standard deviation	Mean	Standard deviation
Years of schooling	11.0	4.4	11.9	4.4
Age	38.7	8.7	39.7	8.9
Gender attitudes index	4.9	1.0	4.9	1.0
Total	**9 642**		**18 181**	

Source: Author's own elaboration with data from the National Survey on the Dynamics of Household Relationships 2016 (ENDIREH).

Table 3 Working married women and domestic violence incidence

Any type of…	%
Domestic violence	34.6
Economic violence	18.5
Emotional violence	29.3
Physical violence	10.0
Husband's random irritability	7.5

Source: Author's own elaboration with data from the National Survey on the Dynamics of Household Relationships 2016 (ENDIREH).

6 Estimation results

6.1 Main results

The coefficients obtained for each type of domestic violence using different methodological approaches are reported in Table 5. In addition to economic, emotional and physical abuse, estimations are also presented for a general indicator of domestic violence (all categories). Column (1) indicates the Ordinary Least Squares (OLS) results obtained when sample selection bias and endogeneity are ignored in the model. As it can be observed, all types of domestic violence have a negative and statistically significant impact on married women's earnings. Findings are alike in column (2) after controlling for sample selection bias, following the correction proposed by Wooldridge (2010) as detailed earlier[26]. Emotional violence is the abuse with the highest impact, followed by economic and physical abuse. However, once the husband's random irritability is used as

[26] The truncated nature in the domestic violence indices for the subgroup of non-working married women prevents the use of the Heckit model as mentioned before.

the instrument for domestic violence and the analysis is readdressed to the group of women completely captive to intimate partner violence, a notable difference is the relevant role played by physical violence when determining causality. Effects are still negative and significant but now larger for physical violence in both columns (3) and (4), the traditional two stage least squares (2SLS) estimation, and the 2SLS procedure with correction for sample selection bias, respectively. Considering column (4) as the preferred specification, a one standard deviation increase in the index of physical abuse decreases women's earnings on average in 6.6 percent. Economic violence also reduces earnings in 5.3 percent and emotional violence in 4.7 percent.

The question at hand is why when causation is tested the stronger implications of physical violence are unfolded. Though an important change is revealed for economic and emotional violence from specification (2) to (4), it is not as substantial as with physical violence. The answer relies as expected, in the nature of the instrument used. At first glance, considering endogeneity is not present, it can be argued that women suffering from economic abuse have no incentives to get better jobs or to pursue higher salaries, because the husbands are anyway controlling all the money and they have no autonomy to dispose of their own salaries. Also, women facing emotional abuse at home can be mentally more affected and therefore more likely to suffer abuse from bosses or co-workers, perceiving as a consequence lower wages. On the contrary, as long as wives exposed to physical violence from husbands can superficially hide the consequences of the abuse and pretend to go along with their employment, their earnings would not have to be affected. A different story to tell when causation is established. The instrument allows to focus the analysis in a particular group of women. Fearful and captive women, that need to be alert at all times because they never know where the sudden rush of anger from husbands will come from. These women are exposed to higher levels of violence since there are no available resources to prevent or evade the abuse. Under these circumstances, physical abuse is more difficult to cover, causing for instance, higher rates of absenteeism at work in order to not show a broken arm, black eye, or even worst, due to an emergency hospital admission. In this sense, the economic or emotional violence causal effect, although is still relevant[27], should not be larger than the impact of physical abuse, because feeling demotivated or not to be concentrated at work is not expected to

[27] As it is observed from the higher coefficients obtained from column (4) when compared to column (2).

have the same negative effect on earnings than not attending work at all; disentangling the true effect of physical violence on women's earnings.

Table 4 Main results – Domestic violence index

	OLS	**OLS – SS**	**IV**	**IV – SS**
	(1)	**(2)**	**(3)**	**(4)**
Economic violence	-0.015***	-0.017***	-0.036***	-0.053***
	(0.0032)	(0.0032)	(0.0092)	(0.0097)
Emotional violence	-0.016***	-0.019***	-0.032***	-0.047***
	(0.0032)	(0.0032)	(0.0081)	(0.0085)
Physical violence	-0.012***	-0.013***	-0.046***	-0.066***
	(0.0033)	(0.0033)	(0.0117)	(0.0123)
Domestic violence	-0.017***	-0.019***	-0.031***	-0.046***
	(0.0032)	(0.0032)	(0.0079)	(0.0083)

Source: National Survey on the Dynamics of Household Relationships (ENDIREH) 2016 and 2006. In columns (1) and (3) robust standard errors in parentheses. In columns (2) and (4) bootstrapped standard errors in parentheses (10 000 replications). All regressions include a constant term, the inverse Mills ratio correction, education, experience, experience squared and the indicator variables: area, ethnic group, children and year of survey. ***Statistically significant at the 99% confidence level.

To rely on the validity of the causal estimations obtained in column (4) on Table 5, additional factors need to be verified in order to claim that the instrumental variables technique is adequate.

The first stage shows the linear prediction of the endogenous variable, domestic violence, on the instrument, the husband's random irritability. Columns (1) to (4) in Table 6 report statistically significant coefficients obtained for this relationship through the IV estimations. Results indicate not only that the first stage exists, but also that women exposed to husband's random irritability are indeed subject to higher levels of domestic abuse, regardless of the type of violence experienced. In addition, to measure the relevance of the instrument used, the F statistic is reported. It is significant and exceeds by far the value of 10 established by Staiger and Stock (1997), so the presence of a weak instrument can be discarded. Lastly, Hausman tests to determine whether domestic violence (all types) is exogenous are performed. The null hypothesis is rejected in all cases, confirming that the IV methodology is appropriated.

Table 5 Additional causality tests

	Economic violence (1)	Emotional violence (2)	Physical violence (3)	Domestic violence (4)
First-stage coefficient				
Husband's random irritability	1.331***	1.503***	1.068***	1.539***
	(0.0410)	(0.0408)	(0.0477)	(0.0422)
F-test for instrument	3720.3	4938.85	2269.55	5243.5
Prob > F	0.0000	0.0000	0.0000	0.0000
Hausman test	14.0	11.4	18.6	10.5
Prob > chi	0.0002	0.0007	0.0000	0.0012

Source: National Survey on the Dynamics of Household Relationships (ENDIREH) 2016 and 2006. Bootstrapped standard errors in parentheses (10 000 replications). ***Statistically significant at the 99% confidence level.

Focusing now on the other variables incorporated in the model, Table 7 reports, per type of domestic violence, the regression estimates obtained for education, potential experience and its square, area, ethnic group and children on earnings, when sample selection bias and endogeneity are considered (specification 4 in Table 5). Education shows a strong and expected positive significant effect. An additional year of schooling is associated on average with a 7.5 percent increase on earnings, a result consistent with the general findings in the literature. On the other hand, ethnic group and having children present a negative impact on earnings. Women belonging to ethnic groups are more likely to grow up in poverty and have less opportunities to excel in the labour market. Similarly, the decisions of married women with children in terms of employment are more dependent on other factors, such as the financial support of the husband, typically the main breadwinner in the household, or child care; as opposed to childless women; having as a consequence a more tangible effect on earnings.

Table 6 Additional determinants of women's earnings

	Economic violence (1)	**Emotional violence (2)**	**Physical violence (3)**	**Domestic violence (4)**
Years of schooling	0.076***	0.075***	0.076***	0.075***
	(0.0023)	(0.0024)	(0.0024)	(0.0024)
Experience	0.008***	0.008***	0.008***	0.008***
	(0.0013)	(0.0013)	(0.0013)	(0.0013)
Experience squared	0.00003	0.00003	0.00003	0.00003
	(0.00002)	(0.00002)	(0.00002)	(0.00002)
Area (urban=1)	-0.0002	-0.002	0.001	-0.001
	(0.0171)	(0.0172)	(0.0172)	(0.0171)
Ethnic group	-0.043**	-0.044**	-0.040**	-0.043**
	(0.0178)	(0.0177)	(0.0179)	(0.0178)
Children (at least one=1)	-0.055***	-0.054***	-0.059***	-0.055***
	(0.0175)	(0.0176)	(0.0174)	(0.0175)

Source: National Survey on the Dynamics of Household Relationships (ENDIREH) 2016 and 2006. Bootstrapped standard errors in parentheses (10 000 replications). All regressions include a constant term, the inverse Mills ratio correction and year of survey variables. ***Statistically significant at the 99% confidence level. **Statistically significant at the 95% confidence level.

6.2 Robustness checking – Husband's observable traits

In section 4.3 has been discussed that the husband's random irritability meets the three conditions to be used as an instrument for DV. Nonetheless, as a robustness check, it is relevant to examine the sensitivity of the results when some of the husband's observable traits are included in the estimations as additional controls. Specifically, given the rich dataset available, it is possible to capture the influence that an alcoholic/drug addict husband, a jealous husband, a workaholic husband or a possessive husband, might have on the analysis. As it can be seen in Table 8, the causal effects of IPV on women's earnings when these four additional variables are explicitly added in the model (column 1) remain very similar to those presented before, when none of them were considered (column 2). Coefficients are still significant and their magnitudes have not been drastically reduced, as it would have been expected in the presence of confounding variables. In addition, none of them with exception of having an alcoholic/drug addict husband play a significant role in the model, as is shown in Table 9. Only women married to alcoholic/drug addict husbands face around a 6 percent reduction on their earnings compared to women with alcohol/drug free husbands. This outcome is by itself engaging,

but most remarkably is the fact that despite the negative correlation found between alcoholic/drug addict husbands and women's earnings, the causal effect of DV does not fade away. These findings provide additional evidence about the relationship between domestic violence, the instrument used and particular personality traits of the husbands, supporting the robustness of the main conclusions drawn in this analysis.

Table 7 Robustness check – Domestic violence index

	IV H - SS (1)	**IV – SS (2)[a]**
Economic violence	-0.045***	-0.053***
	(0.0154)	(0.0097)
Emotional violence	-0.042***	-0.047***
	(0.0143)	(0.0085)
Physical violence	-0.059***	-0.066***
	(0.0204)	(0.0123)
Domestic violence	-0.040***	-0.046***
	(0.0138)	(0.0083)

Source: National Survey on the Dynamics of Household Relationships (ENDIREH) 2016 and 2006. Bootstrapped standard errors in parentheses (10 000 replications). All regressions include a constant term, the inverse Mills ratio correction, education, experience, experience squared and the indicator variables: area, ethnic group, children and year of survey. In addition, results in column (1) include the indicator variables: alcoholic/drug addict husband, jealous husband, workaholic husband and possessive husband. ***Statistically significant at the 99% confidence level.
a. Same results presented before in Table 5, column (4).

Table 8 Husband's observable traits on women's earnings

	Economic violence (1)	**Emotional violence (2)**	**Physical violence (3)**	**Domestic violence (4)**
Alcoholic/drug addict husband	-0.061***	-0.063***	-0.060***	-0.062***
	(0.0114)	(0.0110)	(0.0117)	(0.0112)
Jealous husband	-0.002	0.002	0.002	0.001
	(0.0118)	(0.0125)	(0.0125)	(0.0123)
Workaholic husband	0.004	0.004	-0.001	0.003
	(0.0106)	(0.0105)	(0.0101)	(0.0104)
Possessive husband	0.018	0.023	0.023	0.022
	(0.0171)	(0.0184)	(0.0185)	(0.0180)

Source: National Survey on the Dynamics of Household Relationships (ENDIREH) 2016 and 2006. Bootstrapped standard errors in parentheses (10 000 replications). All regressions include a constant term, the inverse Mills ratio correction, education, experience, experience squared and the indicator variables: area, ethnic group, children and year of survey. ***Statistically significant at the 99% confidence level.

6.3 The traditional measure of domestic violence

Earlier studies on intimate partner violence use a straightforward definition of abuse, as mentioned before. Women exposed to frequent episodes of violence and women that have faced only one incident are group together in a binary variable that takes the value of one for abused women or zero for women never exposed to DV. Although the coefficients obtained from this approach are not directly comparable with those in Section 6.1, it is interesting to report them in Table 10[28].

Similar to results in Table 5, in all the specifications the different categories of IPV present a negative and statistically significant effect on earnings. An important contrast is that the coefficients for economic and emotional DV are lower than the coefficients for physical abuse even when no instrument is used. However, the most relevant finding is the apparent larger effects that all types of domestic abuse exert on earnings when following this approach. Column (4) indicates that women who have experienced physical IPV earn on average 22.4 percent less than women never physically abused by their husbands. Also, lower earnings are observed for married women exposed to economic and emotional violence, with a reduction on earnings of 16.4 and 14.5 percent, respectively. These high magnitudes are not unexpected, given the limited definition of violence implemented (abused at least once against never abused)[29], and reflect the importance of a more flexible definition of DV as the index suggested in this paper, in order to have a more accurate and reliable assessment of the effect of violence on women's earnings. Next, I consider how to reconcile the results obtained from these two different approaches more fully.

[28] A notable difference between Table 5 and Table 10 is that specification in column (2), when using the binary variable, is estimated applying the Heckit model because the variable that captures the abuse is no longer truncated.

[29] They are also according to findings for other studies that use similar definitions of DV (Vyas, 2013; Morrison and Orlando, 1999).

Table 9 Traditional results – Domestic violence binary variable

	OLS BV (1)	**HECKIT BV (2)**	**IV BV (3)**	**IV – SS BV (4)**
Economic violence	-0.040***	-0.050***	-0.113***	-0.164***
	(0.0087)	(0.0088)	(0.0284)	(0.0298)
Emotional violence	-0.033***	-0.048***	-0.098***	-0.145***
	(0.0076)	(0.0078)	(0.0248)	(0.0264)
Physical violence	-0.069***	-0.087***	-0.155***	-0.224***
	(0.0111)	(0.0114)	(0.0392)	(0.0408)
Domestic violence	-0.033***	-0.046***	-0.096***	-0.142***
	(0.0073)	(0.0074)	(0.0243)	(0.0257)

Source: National Survey on the Dynamics of Household Relationships (ENDIREH) 2016 and 2006. In columns (1), (2) and (3) robust standard errors in parentheses. In column (4) bootstrapped standard errors in parentheses (10 000 replications). All regressions include a constant term and education, experience, experience squared, area, ethnic group, children and year of survey control variables. ***Statistically significant at the 99% confidence level.

Table 11 presents the results from an exercise that allows a potential comparison. Using the coefficients obtained in Table 5 and Table 10, Equation (2) is evaluated under two scenarios. Column (1) shows the earnings of a hypothetical woman experiencing the highest level of each type of IPV according to the index of domestic violence created. Column (2) reports the earnings for the same hypothetical case but measuring DV as a binary variable. Column (3) and column (4) replicate these two scenarios respectively, when causality is not addressed. For a woman experiencing the highest level of abuse that can be captured following these two different approaches, earnings are clearly lower in all cases if the index of IPV is used.

The implications of these findings are meaningful. For instance, using the traditional definition of DV, estimations for a woman facing the highest level of physical abuse indicate monthly earnings around 4 534 Mexican pesos. However, a substantial reduction is observed if the index proposed in this paper as a measure of DV is implemented. Earnings are reduced in 46.9 percent, indicating monthly earnings around 2 407 Mexican pesos as a maximum. These results reveal that the negative effect of domestic violence on women's earnings has been traditionally underestimated and highlight the importance to develop more precise measures of intimate partner violence.

Table 10 Women's earnings – Highest level of domestic violence

	IV - SS (1)	IV - SS BV (2)	OLS - SS (3)	HECKIT BV (4)
Economic violence	3 815	4 850	4 911	6 258
Emotional violence	3 814	5 024	4 772	6 318
Physical violence	2 407	4 534	4 675	6 030
Domestic violence	3 631	5 057	4 627	6 333

Source: National Survey on the Dynamics of Household Relationships (ENDIREH) 2016 and 2006. Exercise considering a hypothetical woman with average years of education (11.6) and experience (21.7), living in an urban area, not belonging to an ethnic group, with children and interviewed in 2016. Maximum levels of domestic violence: Economic-7.0, Emotional-8.0, Physical-12.6 and Domestic-9.2. Earnings are expressed in real prices. Base year 2016.

7 Conclusion

Married working women facing domestic violence not only suffer the physical and mental consequences of the abuse at home. In addition, their levels of productivity at the workplace are affected, leading to lower earnings. This study provides the first empirical evidence on the causal effects of intimate partner violence, when the levels and the frequency of abuse are considered. An index for domestic violence is created to capture the variation observed, challenging the traditional use of a binary variable within this context. This new approach allows to incorporate into the analysis useful information which readily available but typically ignored in other studies.

Evidence is found indicating that women exposed to higher levels of IPV, economic, emotional or physical, struggle with lower salaries. After a smaller association initially observed between earnings and DV, the true causal effects are revealed when the estimations are performed using the instrumental variables technique. The husband's random irritability is the instrument used, readdressing the analysis to a group of even more vulnerable abused married working women, captive by unpredictable rushes of anger from husbands. Physical violence is found to be the type of abuse with the largest negative incidence on earnings, followed by economic and emotional abuse. The estimated effects show higher harmful impacts of domestic violence on women's earnings when the indicator proposed in this study is implemented compared to the effects obtained when the traditional measure of IPV is adopted.

Mexico has a lower female labour market participation and higher gender-based violence rates. This study aims to draw attention to the importance of these topics and to stimulate research and public polices in the country to improve the position of women in the Mexican society.

Next steps should be addressed to develop better measures of domestic violence to establish more precise estimations on the impact of intimate partner violence over many other aspects affecting women's lives.

Appendix

Table 11 Current relationship – During the last year how often has your husband…

Physical violence
1. pushed you or pulled your hair?
2. tied you up?
3. kicked you?
4. thrown any object to you?
5. hit you with his fist or any object?
6. tried to choke you?
7. assaulted you with a knife or blade?
8. shot you with a firearm?
9. demanded you to have sex, even if you do not want?
10. forced you to do things you do not want when having sex?
11. physically forced you to have sex?
Emotional violence
12. embarrassed, offended, belittled or humiliated you?
13. ignored or not given you affection?
14. accused you of having affairs?
15. made you feel fear?
16. threatened about leaving/abandoning you, hurt you, take away the children or get you thrown out of the house?
17. locked you in, forbidden you from going out or being visited?
18. spied, followed you when leaving home or suddenly appears in places that you are at?
19. threatened you with a weapon or that he will burn you?
20. threatened to kill you, himself or the children?
21. destroyed, thrown away or hidden things belonging to you or the household?
22. stopped talking to you?
23. manipulated your children or relatives against you?
24. been very angry because the housework is not done, the food is not prepared the way he likes it or he believes you are not fulfilling your duties?

Economic violence
25. forbidden you to work or study?
26. appropriated possessions from you?
27. spent money needed for household expenditures?
28. not provided money needed for household expenditures or threatened you he will not provide it?
29. having money, refused to provide enough for the household expenditures?
30. complained about the way you spend the money?

Table 12 Male and female roles in the household – Do you believe…

2016	2006
1. men should earn higher salaries than women?	1. women have the same ability as men to earn money?
2. women should be equally responsible as men as financial providers?	2. men should be the financial providers?
3. men should equally share with women the domestic responsibilities, take care of the children, the elderly and the sick?	3. good wives should always obey their husbands?
4. women should have the right to go out alone at night to have fun?	4. women can choose their friends even if their husbands dislike them?
5. women should dress modestly to prevent harassment from men?	5. husbands can beat their wives if they do not fulfill their duties?
6. married women should have sex with their husbands whenever men want?	6. women should have sex with their husbands even if they do not want to?

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