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The impact of minimum wage on the labour market of an economy with a large informal sector. The case of Indonesia.

A Master's Thesis submitted for the degree of
"Master of Science"

supervised by

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Vienna, 8 June 2015

MSc Economics

Affidavit

I, Aurélie de Gournay

hereby declare

that I am the sole author of the present Master's Thesis,

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51 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

Vienna, 8 June 2015

Signature

I would like to express my gratitude to all the faculty members from the Institute for Advanced Studies, IHS, for their availability, and more particularly to my thesis advisor, Derya Uysal, for her valuable contribution and her constant support.

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Abstract

This thesis evaluates the impact on minimum wage on labour market participation in an economy with a large informal sector. In Indonesia, minimum wages are set up at the provincial level, following national directives. In 2001, West Sumatra significantly increased its minimum wage, while most of the other provinces did not, thus offering a perfect quasi-natural experimental setting. The objective of this research is to discuss how this increase in minimum wage influenced the participation of non-governmental workers.[1] I used synthetic control method to analysis the effect directly on the aggregate values for the employment level and the proportion of informal workers among employed individuals. I found that the minimum wage resulted in a shift from the informal to the formal sector: without changing the number of non-governmental employed workers, the increase in minimum wage reduced the share of informal workers by 6% within the six years following the intervention. I also found that the increase in minimum wage did not not have any significant impact on workers aged 30 or less.

[1] The informal sector being underrepresented among governmental workers, I focused on non-governmental workers only.

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Abbreviations

CPI Consumer Price Index

DiD Difference-in-Difference

IFLS Indonesian Family and Life Survey

i.i.d. independently and identically distributed

ILO International Labour Organization

GDP Gross Domestic Product

MSE Mean Squared Error

MSPE Mean Squared Prediction Error

RMSPE Root Mean Squared Prediction Error

US United States of America

1 Introduction

> *Productivity growth in Indonesia expanded significantly in recent year [...]. This growth has not however been accompanied by higher real wages.* (International Labour Organization 2008b:8)

Minimum wage is often thought as a tool to improve social justice: in developing economies, they tend to grow less than GDP or average wages (International Labour Organization 2008a) and it can be argued that increasing the minimum wage reduces income inequalities. There is therefore an ongoing debate in the literature on how the minimum wage impacts the labour market.

Indonesia provides a quasi-natural experiment to evaluate the impact of an increase in minimum wage. Indeed, the minimum wage is fixed at the provincial[2] level, following national directives. In 2000, the national government announced a general increase of the minimum wages following which, in 2001, one region, West Sumatra, increased its minimum wage significantly more than the other regions. I will evaluate the impact of this increase in West Sumatra, using the other regions to construct the comparison group.

One of the key challenges to reliably measure the effect of minimum wage lies in the choice of the econometrics method. Kuehn (2014) reviewed the major empirical studies contributing to the debate on the minimum wage effect on employment . He showed that many studies did not select the comparison group rigorously, without punctilious matching, and therefore reported biased effect on the labour market. Neumark et al. (2014) also point out the importance, and the difficulty, of selecting an appropriate control group. They showed that using controls within a narrow geographic region[3], for instance within the same region or the same county, is not enough to ensure the quality of the comparison group. I will therefore use a relatively recent method, developed by Abadie et al. (2010) to build a synthetic control in order to measure the unbiased effect.

Using this synthetic control approach, I will analyze the effect of the minimum wage increase in 2001 in West Sumatra on the number of employed non-governmental workers and the proportion of informal non-governmental workers among those employed non-governmental workers as well as among young[4] workers. The objective is to determine whether an increase in minimum wage

[2] Throughout the thesis, the words *province* and *region* will be used interchangeably.

[3] Many studies applied econometrics methods, such as Difference-in-Difference, to different regions/states/provinces within the same country arguing that units that are geographically close should be influenced by similar unobservable factors and experience similar employment shocks, and hence that they provide a good basis for comparison.

[4] *Young* workers are workers aged less than 30 years old.

influences workers' participation in the labor market and whether it creates a shift between the formal and the informal sectors.

The thesis is structured as follows: the second section offers a brief snapshot of the ongoing debate on the impact of minimum wage on employment. It presents, in a nutshell, the main theoretical results and reviews the different conclusions of empirical studies evaluating the effect of minimum wage in developing economies. The third sections describes the methodology: how it extends the Difference-in-Difference approach, how it is constructed and how to implement it. The fourth section presents the data used in this paper. It shortly describes the survey from which the data was extracted; and it explains how the variables were constructed and what samples are used in this research. The fifth section present the results of this thesis.[5] It shows the impact on minimum wage on the level of employment and the share of informal workers for all non-governmental workers and for young non-governmental workers. It discusses the main results as well as the possible limits of the model. Finally, the sixth section offers some concluding remarks.

[5]Hainmueller J, Abadie A, and Diamond A, developed *synth*, a statistical software that implements synthetic control methods for causal inference in comparative case studies. This software determines the best weighting scheme and predict the outcome of interest in the synthetic control. All results presented in this section are computed using the Stata version of this programme.

2 Literature review

2.1 Theoretical perspective: the ambiguous effect of minimum wage

Neo-classical model

In the traditional neo-classical model, with homogeneous workers, an increase in minimum wage yields in a decrease of employment (Strobl & Walsh 2008): in perfect competition, labour demand decreases as labour costs increase, and labour supply increases. The unemployment resulting from an increase in minimum wage corresponds to the difference between the new levels of labour supply and labour demand. In oligopolistic and monopolistic markets, firms are the price-setter and the impact on employment is the same.

Let's now consider a standard neo-classical model with heterogeneous workers. Assuming that low-skill workers, hence with low wages, are more affected by an increase in minimum wage than high-skill workers, with high wages; an increase in minimum wage tends to compress the left part of the wage distribution while the right part remains unchanged (Herr et al. 2009). In this case, the employment level of high-skill workers will remain unchanged, while employment of low-skill workers will decrease.

In standard neo-classical models (with constant return to scale and neutral monetary policies), it seems that implementing, or increasing the minimum wage is always detrimental to the economy. One of the only exception to this rule would be the case of monopsony where workers are paid less than their marginal productivity (Terrell & Almeida 2008). Indeed, an increase in minimum wage, as long as its level remains lower than the marginal productivity of labour, will increase employment: the firm will not decrease its labour demand and more workers will be willing to work.

Keynesian model

In the Keynesian model with homogeneous workers, an increase in minimum wage does not have any direct impact on employment level (Herr et al. 2009): if labour costs increase, firms will increase their prices (at least in closed economy) and with a proportional relationship between wages and prices level, demand, and consequently production level, would not be affected. With mark-up prices, even if firms do not increase prices as much as the increase of labour costs, they

will still make profit – as long as the increase in minimum wage remains reasonable – and their production level will remain unchanged. On the other hand, an increase in minimum wage might have indirect effects. First, an extremely low increase (or even decrease) in minimum wage, will lead to deflation and therefore reduce both production and employment. Second, An extremely high increase in minimum wage will lead to inflation which in turn will be corrected with restrictive monetary policies, resulting in a decrease of both production and employment (Herr et al. 2009).

In the case of heterogeneous labour force, when the minimum wage is increased to boost low-skill workers' wages, its total effect is more complex (Heintz & Pollin 2003). Firms using mostly low-skill labour will tend switch to a less labour-intensive production function and adjust their prices. Indeed, with increasing low-skill labour wages, firms will minimize their costs by reducing their workforce and possibly using a new technology to compensate this loss in production input. On the other hand, industries mostly using high-skill workers will tend to switch to a more labour-intensive production and also adjust their prices. The outputs of the first category of firms (using low-skill labour) are indeed likely to be inputs in the production function of the second category of firms (using high-skill labour). Firms will minimize their costs by reducing the use of such inputs and compensate by increasing their workforce. As a consequence, the total effect of an increase in minimum wage is not clear. First, although there seems to be a a general switch from low-skill to high-skill employment, the net impact on employment is undefined. Second, the whole price structure changes and its impact on the demand is ambiguous: the demand of low-income households should increase because they have a higher propensity to consume and are more affected by an increase in minimum wage. However, with a decrease in low-skill employment, the evolution of the aggregate demand, and hence production function and employment, remains undefined.

Including the informal sector

The above discussed models only consider the formal sector. Employment response to minimum wage is even more ambiguous in economy when the informal sector is included.

In traditional models (Terrell & Almeida 2008), an increase in minimum wage has no effect on wages in the informal sector. Indeed, by definition, this sector is out of reach with regard to legislation and labour standards. If we consider the above discussed neo-classical model, an increase in minimum wage displaces workers from the formal to the informal sector as labour costs increases in the formal sector while they remain unchanged in the informal sector. In such

settings, the total effect on employment depends on the absorption capacity of the informal sector.

However, defining the informal sector is not that trivial. It does not only include workers accepting low-wage jobs because they do not have any other options: the informal sector can include high-paid jobs (Terrell & Almeida 2008), and self-employed who are better off in the informality because formal jobs are undesirable (Heintz & Pollin 2003). In such cases, increasing the minimum wage might render the formal sector more attractive to some workers and increase formal employment.

2.2 Mixed empirical evidence of the impact of minimum wage

Since Card and Krueger's paper on minimum wage impact in the fast-food industry in New Jersey (Card & Krueger 1993), an extensive literature on the topic has been developed.[6] In the beginning, research mainly focused on developed countries.[7] Most researchers found that minimum wage increase has a insignificant (Card 1992, Bazen et al. 1994a, Card & Krueger 1995, Dolado et al. 1996, Dickens & Draca 2005, Draca et al. 2008) or even a negative (Bazen & Martin 1991, Ragacs 1993, Bazen et al. 1994b, Currie & Fallick 1996) effect on employment level, especially among young workers (Neumark & Wascher 1992, Deere et al. 1995, Bazen & Skourias 1997, Abowd et al. 1997). Of course, developing economies, where the share of informality is high, might react differently.

In the 80's and 90's, literature mainly focused on the Latin American region and reported mixed effects on employment. For example, Bell studied formal manufacturing sector in both Columbia and Mexico and found different results (Bell 1997): while minimum wage had a highly significant disemployment effect in Colombia (especially on the low-skilled), no effect was found in Mexico. Bell explained her results by the difference in compliance: while minimum wage are effective in Columbia, they are ineffective in Mexico.[8] Other studies reported similar results: a decrease in employment (Montenegro 2003, Foguel et al. 2001) or no significant effect (Lemos 2004, Cunningham & Siga 2006).[9]

[6] This section does not aim at providing an exhaustive literature review but rather at presenting the main different views and results.

[7] Herr et al. provide a very useful summary of the main empirical studies of the effects of minimum wage increases in developed countries (Herr et al. 2009).

[8] Mexican wages are concentrated on the left-tail of the distribution, even below the minimum wage level while they are closer to the mean in Columbia.

[9] Cunningham provides an helpful synthetic summary of the main empirical studies on the impact of an increase in minimum wage in Latin America (Cunningham 2007).

Maloney and Nuñez (2004) found that minimum wage led to an increase in unemployment, even more in the formal sector than for self-employment.[10] They argued that informal workers chose to work informally given the lack of better outside option, and an increase in minimum wage makes them even better off in the informal sector. Their result suggests that an increase in minimum wage decreases employment, especially in the formal sector. Nevertheless, although self-employed might be worse off with an increase in minimum wage (as it reduces their profit), the reported effect might not be representative of the response of the whole informal sector.

Fajnzylber (2001) evaluated the minimum wage impact in Brazil in the formal and informal sectors as well as among the self-employed and reported an increase in unemployment, especially in the informal sector. He computed employment elasticities by comparing earning effects and the workers movement in and out of the labour market (workers becoming unemployed or inactive). He reported that elasticities were negative for both the formal and the informal sector and higher in absolute value for informal workers. His findings is consistent with workers choosing informality because the formal sector is unattractive, and hence moving to the formal sector after the minimum wage increased.

Recent research also focuses on the minimum wage in Southeast Asia and some papers have drawn a special attention to the Indonesian case, the focus of this thesis.

Rama's findings (2001), using data at the regional level, showed limited impact on employment : doubling the minimum wage only decreased formal employment by 2% in average in Indonesia. Alatas and Cameron (2008) came to a similar conclusion using the successive minimum wage increases in 1990-1996 in Jakarta and West Java, and found no significant disemployment. Islam and Nazara's results (Islam 2002, Islam & Nazara 2010), a very small disemployment effect, are also in line with these studies .

Bird and Manning (2002) found that the 1997 Asian financial crisis which impacted Indonesia between 1997 and 1998 – and hence the large decrease in real minimum wage in 1998 [11] – resulted in a shift from formal to informal employment . Their findings are coherent with the hypothesis that workers chose informality when formal jobs are not desirable: with lower real minimum wage, more workers will follow the path towards the informal sector.

Comola and de Mello (2011) reported that an increase in Kaitz index[12] leads to a decrease in formal employment, largely compensated by an increase in informal employment . They argued

[10] They used *self-employment*, defined as being a male self-employed or micro-entrepreneurs, as a *proxy* for informality, informal workers being overrepresented in self-employment.

[11] This drop in real wage can be observed in figure 1 which shows the real regional minimum wage for the period 1993-2007.

[12] The Kaitz index is the ratio of the minimum to the mean wage.

that this demonstrates that increasing the minimum wage destroys formal jobs and increases informality. This seems to contradict Bird and Manning's result (2002) but is coherent with the traditional theory and the *lighthouse* effect.[13]

[13]The *lighthouse* effect is the fact that a minimum wage increase reduces formal employment and has spillover effects on the informal sector where wages also increase.

3 Methodology

3.1 Generalizing the Difference-in-Difference method

Several econometrics methods are traditionally used to evaluate the impact of policy interventions on aggregate outcomes. The synthetic control method, developed by Abadie et al. in a series of papers (Abadie & Gardeazabal 2003, Abadie et al. 2010, 2012, 2014) offers a useful generalization of the Difference-in-Difference (DiD) settings. The DiD method usually uses disaggregate units – data at the micro level – to measure the treatment effect on individuals and infer impact on aggregates. This is very convenient when data is not available at the same level of aggregation as the outcome of interest. On the other hand, only measuring the impact at the micro-level to deduce conclusion at the macro-level might result in measurement error as it *only* measures uncertainty about the aggregate population: for instance, studies on the minimum wage impact only evaluates the individual likelihood to be employed, or the individual employment elasticity, and speculates on the response of the whole labour market. Such errors are avoided with the synthetic control method which directly evaluates the impact of a given policy on the aggregate outcome of interest, and only considers aggregate(d) variables: i.e. with such method, it is possible to directly estimate the response of the labour market at the macroeconomic level.

Even when aggregate data is available, there remains some level of uncertainty as the capacity of the control group to be a good counterfactual. With DiD, one has to find a control group with very similar characteristics to the treatment group. This might not be an easy task, especially in the case of developing or emerging economies which often have some very specific features. By building a synthetic control group, one can use data-driven procedures to perfectly fit the counterfactual trajectory by constructing a virtual unit which is the exact mirror of the treated region, but does not receive any treatment.

Lastly, one limitation of the DiD model is that unobservables do not vary over time. This might be a problem in general but even more in the case of labour markets which are clearly driven by unobservable forces which effect is time-variant (such as governmental policies, comparative advantages, etc.). The synthetic control method allows for the effect of unobservable cofounders to vary over time.

3.2 The synthetic control method

This section briefly presents the synthetic control method developed by Abadie et al. (2010). Further details are available in their article.

Suppose that there are $J + 1$ regions. Without loss of generality, we shall assume that the treated region is the first one, and that the J other regions compose the potential controls pool. Suppose also that one observes T periods and that the treated unit is uninterruptedly exposed to the treatment after the initial intervention period ($t = 1, \ldots, T_0, \ldots, T$ with T_0 the initial intervention period).

Using the common notations in the treatment effect literature, the observed outcome for unit i at time t is:

$$Y_{it} = Y_{it}^N - \alpha_{it} D_{it} \tag{1}$$

,where Y_{it}^N denotes the outcome that would be observed in unit i, at time t, in the absence of intervention; Y_{it}^I the outcome that would be observed if the unit i is exposed to the intervention at time t; the indicator of treatment D_{it} is an indicator function taking the value 1 for $i = 1$ and $t > T_0$ (i.e. for the treated unit after the initial intervention period); and the parameter of interest, the effect of the intervention for unit i at time t, is given by:

$$\alpha_{it} = Y_{it}^I - Y_{it}^N \tag{2}$$

The objective is to estimate the intervention effect on the treated unit, i.e. for $i = 1$ and $t = T_0 + 1, \ldots, T$. To do so, it is assumed that the intervention does not have any effect preintervention, that is: $Y_{it}^I = Y_{it}^N$ for $t = 1, \ldots, T_0$ and for $i = 1, \ldots, J + 1$. The usual "no interference between units" assumption should also hold (the outcome of non-treated regions is not affected by the intervention, i.e. there is no externalities).

Let's suppose that observed outcomes in absence of intervention are given by a factor model:

$$Y_{it}^N = \delta_t + \theta_t Z_i + \lambda_t \mu_i + \epsilon_{it} \tag{3}$$

,with

δ_t ... unknown common factor with constant factor unit
θ_t ... (1xR) vector of unknown parameters
Z_i ... (Rx1) vector of observed covariates
λ_t ... (1xF) vector of unobserved common factors
μ_i ... (Fx1) vector of unknown factor loadings
ϵ_{it} ... unobserved i.i.d. transitory shocks with $\mathbb{E}[\epsilon_{it}] = 0$

It is of course impossible to observe both Y_{it}^N and Y_{it}^I for the same unit. As the parameter of interest is the treatment effect on the treated, it is necessary to estimate Y_{1t}^N, i.e. the outcome that would have been observed in the treated unit in the absence of intervention. In order to estimate the counterfactual, let's consider $W = (w_2, \ldots, w_{J+1})'$, a ($J$x1) vector of non-negative weights which sums up to 1.[14] The value of the outcome for a synthetic control is a particular weighted average of all the regions in the control donors pool:

$$\sum_{j=2}^{J+1} w_j Y_{it} = \delta_t + \theta_t \sum_{j=2}^{J+1} w_j Z_j + \lambda_t \sum_{j=2}^{J+1} w_j \mu_j + \sum_{j=2}^{J+1} w_j \epsilon jt \tag{4}$$

Abadie et al. (Abadie et al. 2010) showed that, if there exists $W^* = (w_2^*, \ldots, w_{J+1}^*)'$ such that:

$$\begin{aligned} &\sum_{j=2}^{J+1} w_j^* Y_{jt} = Y_{1t} \quad \text{for} \quad t = 1, \ldots, T_0 \\ &\text{and} \quad \sum_{j=2}^{J+1} w_j^* Z_j = Z_1 \end{aligned} \tag{5}$$

, then, if $\sum_{t=1}^{T_0} \lambda_t' \lambda_t$ is non-singular,

$$\begin{aligned} Y_{1t}^N - \sum_{j=2}^{J+1} w_j^* Y_{it} = &\sum_{j=2}^{J+1} w_j^* \sum_{s=1}^{T_0} \lambda_t \left(\sum_{n=1}^{T_0} \lambda_n^{'} \lambda_n \right)^{-1} \lambda_s' (\epsilon_{js} - \epsilon_{1s}) \\ &- \sum_{j=2}^{J+1} w_j^* (\epsilon_{jt} - \epsilon_{1t}) \end{aligned} \tag{6}$$

They also showed that (6) converges in probability towards zero under regular assumptions

[14] Although this assumption can be weakened, it grants weights with similar properties than probabilities and hence limits the extrapolation error which might result from a model allowing for negative weights, or for weights which does not sum up to 1.

and if the number of preintervention periods is large enough compared to the range of transitory shocks. In other words, if the synthetic control fits perfectly the treatment unit preintervention, then, it faithfully reproduces the counterfactual trajectory of the outcome of interest.

Of course, it is often impossible to build a synthetic control such that (4) holds exactly and the method is also suitable if (4) holds approximately. Then, the effect of the policy intervention (2) can be estimated by:

$$\widehat{\alpha}_{it} = Y_{1t} - \sum_{J=2}^{J+1} w_j^{**} Y_{jt} \tag{7}$$

,where $W^{**} = (w_2^{**}, \ldots, w_{J+1}^{**})'$ is the optimal vector of weights such that (4) holds exactly or almost exactly.

If the treatment is found to have significant impact on the outcome of interest, placebo tests can be run to confirm that the effect measured is solely due to the intervention. Typical placebo tests would consist in running the same regression for all potential controls, i.e. consider the controls as *treated unit* and evaluate a possible treatment effect. If the intervention is found to have an effect in the control regions, it means that the model is not suitable either because of identification issues, or because of missing information. It is also possible to apply the procedure with a different initial intervention period.

3.3 Implementation

Treatment

Figure 1 shows the deflated increase in minimum wage for all regions included in IFLS for the period 1993-2007. Real minimum wages slightly increased between 1993 and 1996, dropped between 1997 and 1998 when Indonesia implemented a restrictive monetary policy in response to the 1997 Asian financial crisis and went back to their 1995 level in 2000 (Lane 1999). In 2001, the government decided to increase the minimum wage as it had not grown as fastly as individual productivity or GDP and the minimum wage increased by 25% at the national level (Dhanani & Islam 2004). In Indonesia, each province defines its minimum wage, following the directives given by the national government. As a result, the minimum wage was increased significantly more – by 40% – in West Sumatra than in other regions.

The treatment is the significant additional increase in the regional minimum wage in West

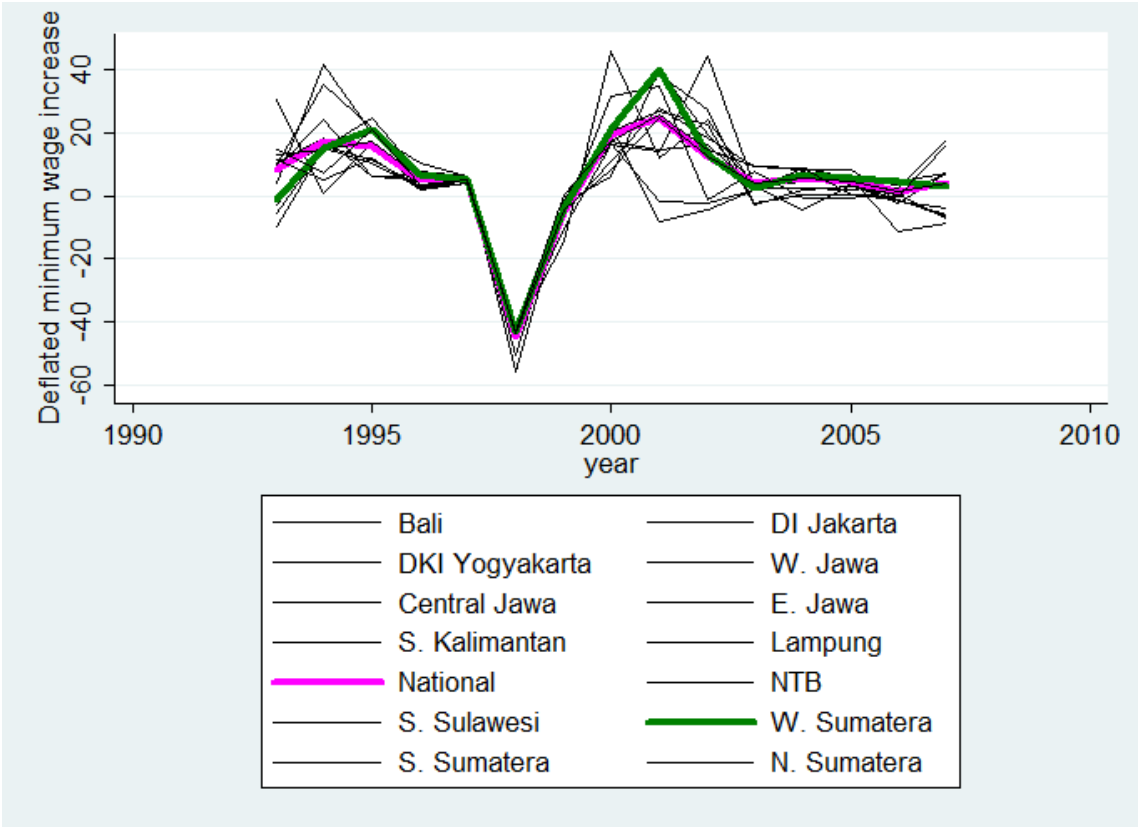

Figure 1: Yearly deflated increase in minimum wage 1993-2007, all regions

Sources: The yearly increase in minimum wage was computed using data for the regional minimum wage levels between 1992 and 1997 (Rama 1996), the national minimum wage between 1992 and 1997 (Badan-Pusat-Statistik (Statistics Indonesia)), the regional and national minimum wage growth between 1997 and 2007 (Badan-Pusat-Statistik (Statistics Indonesia)), and the national and regional CPI and inflation between 1992 and 2007 (Badan-Pusat-Statistik (Statistics Indonesia)).
Notes: The increase for year y_t corresponds to the increase between y_{t-1} and y_t, i.e. 1993 increase is the increase between 1992 and 1993.

Sumatra in 2001, i.e. the difference between the regional and national increase. In other words, the national level of minimum wage is used as a proxy for the *standard* increase of minimum wage and the intervention is the *true* regional policy (the difference between national and regional policies). It means that the other regions, included in the potential donors pool, might also have increased their minimum wage in 2001. The result might be an underestimated treatment effect as it only measures the impact of an additional increase and not the total effect of the increase of the minimum wage.

Potential controls

When constructing the synthetic control group, it is critical to remove from the potential donors pool, all regions which experienced a similar treatment in the preintervention period. Four regions increased their minimum wage by more than 10% more than the national level during the period 1993-2001 and have therefore been removed from the potential donors pool: South Kalimantan, Bali, Djakarta and South Sulawesi. Figure 2 shows the increase of minimum wage of all regions which are considered as potential donors. It shows that only West Sumatra has increased its minimum wage significantly more than the national level between 1993 and 2001.

Abadie et al. (2010) did not control if potential donors experienced an intervention similar to the treatment after the initial intervention period. Following their model, all donors that did not implement an increase in minimum wage pre-intervention are considered as potential donors, independently from their post-intervention policies. If anything, this might also result in an underestimated treatment effect: provided that these donors be included in the synthetic control, there is no reason to assume that their labour market would react differently, and the measured difference in employment – the treatment effect – will be lower than in the absence of intervention.

Covariates

In the synthetic control approach, the objective is to construct a virtual control unit which is the perfect mirror of the treated unit, in everything but the treatment. Covariates should therefore be chosen because of their explanatory power and help select the best potential donors to include in the virtual control unit.

The initial set of covariates includes variables that are typically considered in the literature: demographic information (gender, age), marital status, education level, information on the labour market (field, working time, etc.). Linear combinations of these covariates should be tested and the one which minimizes the mean squared prediction error (MSPE)[15] should be considered for the optimal set of covariates. If the outcome of interest is nonlinear in some of

[15]The synthetic control is a weighted average of all control regions. This weighted average is used to estimate, or *predict* the counterfactual trajectory of the treated unit. The MSPE is therefore the mean squared difference between the outcome of interest in the syntetic control and the treated region. The MSPE should be minimized for the preintervention period: a good counterfactual is a perfect mirror of the trajectory of the outcome of interest in the treated region before the intervention took place.

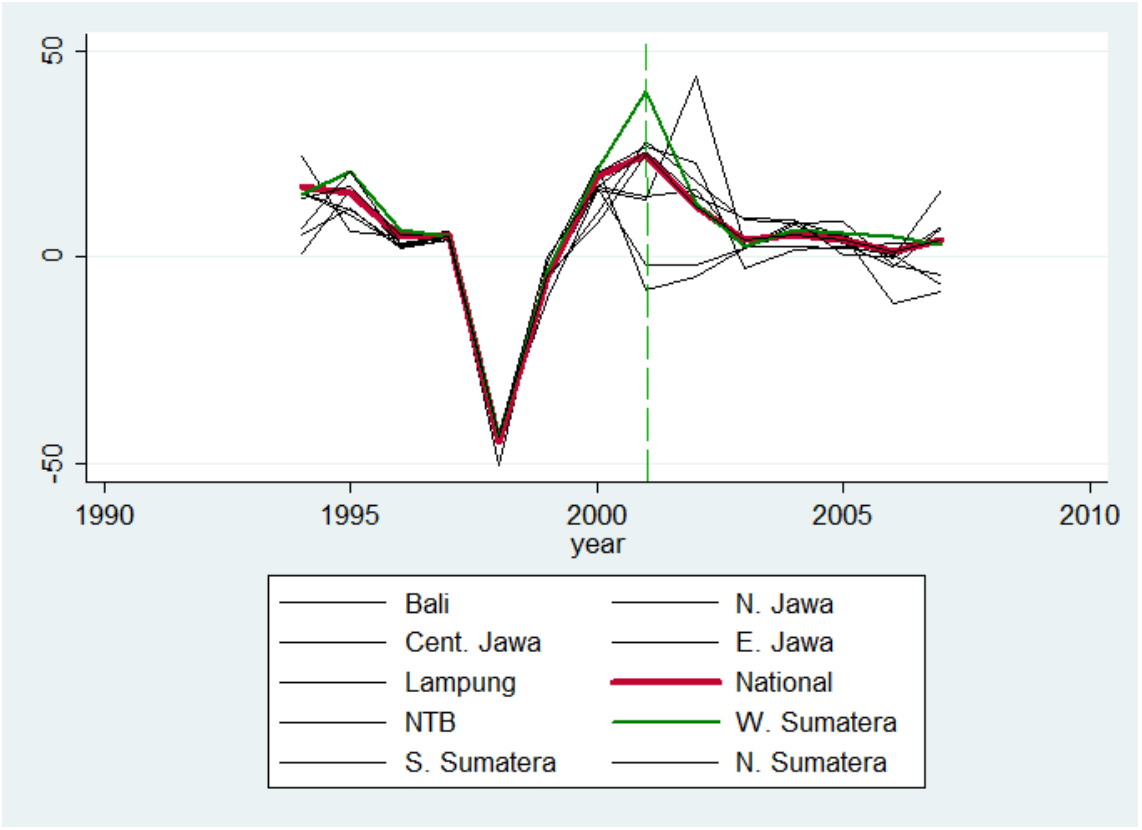

Figure 2: Yearly deflated increase in minimum wage 1993-2007, donors pool

Sources: The yearly increase in minimum wage was computed using data for the regional minimum wage levels between 1992 and 1997 (Rama 1996), the national minimum wage between 1992 and 1997 (Badan-Pusat-Statistik (Statistics Indonesia)), the regional and national minimum wage growth between 1997 and 2007 (Badan-Pusat-Statistik (Statistics Indonesia)), and the national and regional CPI and inflation between 1992 and 2007 (Badan-Pusat-Statistik (Statistics Indonesia)).
Notes: The increase for year y_t corresponds to the increase between y_{t-1} and y_t, i.e. 1993 increase is the increase between 1992 and 1993. The dashed line represents the intervention period (2001).

the variables, it is possible to include penalty terms.[16] This is helpful if one potential control shares many characteristics with the treatment unit but with one major difference having a determinant role in predicting the dependant variable. Abadie et al. (2010) give the example of race to explain some labour market outcome in the context of the U.S. : although a state might be very similar to the treated state, if it is comprised of a vast majority of black people while the treated unit is comprised of a vast majority of white people, it might fail to explain

[16]Penalty terms are increasing functions of the distance between the true value of the treated unit and the virtual control.

the outcome of interest. In the model evaluated in this thesis, there is no reason to believe that the outcome is nonlinear in the cofounders; thus no penalty terms are included.

Weighting scheme

The virtual control is constructed for each set of explanatory variables. It grants every potential donors with a (nonnegative) weight such that the MSPE is minimized and the synthetic control fit the treated unit as well as possible. The combination of weights and covariates that mirrors the best the treatment unit pre-intervention is the optimal synthetic control.

4 Dataset and sample

4.1 The Indonesian Family and Life Survey

The IFLS is a longitudinal socioeconomic survey conducted in four waves (in 1993, 1997, 2000 and 2007) by the research organization *RAND corporation* in partnership with Indonesian universities and research centers (RAND). For this thesis, only the three most recent waves (1997, 2000, 2007) were considered. The survey covers 14 of the 27 Indonesian provinces and contains information on more than 30'000 individuals (in each waves), representing around 83% of the population. Each waves' questionnaires include information on respondents' history (work, education, social coverage, income, etc.) providing data on 45'470 individuals in total, for the period 1993-2007, the period of interest of this research.

As often in such surveys, especially when waves are relatively distant in time, and especially for surveys held in developing countries, it is difficult to have complete information for all individuals, i.e. for most of the respondents, some of the variables of interest during the 15 years studied include missing information. When traditional microeconometrics techniques such as DiD are used, all individuals with one or several missing datapoints should be dropped. This considerably reduces the dataset size, hence compromising results' significance. One of the added-value of synthetic control method is that it only deals with aggregate variables. Researchers can therefore use all datapoints to compute aggregates for each period and in each region, even though individual information might be discontinuous.

4.2 Description of key variables

The IFLS includes very diverse, and complete, information on individuals' medical, health, education, coverage, working, etc. history, as well as their community. It is therefore important to clarify the rational behind the main variables of interest and how they were constructed:

Worker Individuals are considered *workers* if their primary activity is a job for which they receive financial compensation, i.e. *unpaid family workers*, or individuals attending school while working were excluded. Only individuals who are employed in the year in question are considered *workers*, as the *unemployed* status is less clear in developing countries. Workers for which it was unclear whether they were in the formal sector or informal sector (those who did not provide information on their coverage status) were excluded not

to bias the results. A worker is therefore either a formal or an informal worker, they can be employed by the government, by the private sector or self-employed.

Formal worker A formal worker is the main beneficiary from any kind of employment-related coverage. Workers benefiting from "formal coverage", but who are not the main beneficiaries are not counted as formal workers.

Informal worker *A contrario*, informal workers explicitly mention not to be the main beneficiary of any employment-related social coverage. They might of course benefit from such coverage from an other member of their household, subscribe to private insurance, or benefit from *Askesin*, the Indonesian social programme for the Poor.

Manufacturing worker The manufacturing industry playing a critical role in Indonesian economy (Del Carpio et al. 2012), the number of non-governmental manufacturing workers was included as an indicator of the structure of the labour markets in terms of industries.

Agricultural worker The proportion of informal workers being generally larger in this industry than in others, the number of non-governmental agricultural workers was included as a potential explanatory variable.

Education level In Indonesia, more than 90% of individuals went to primary school but only half of the population started high school (World-Bank). The share of individuals who attended junior high school, as well as the share of individuals who attended senior high school therefore serve as two good indicators of the level of education.

Number of worked hours The number of worked hours per week is the average number of hours worked per week over the previous year, or, when such information was not available, the number of hours worked the week before the interview.

Number of worked weeks The number of worked weeks is the average number of weeks over the previous year, or, when such information was not available, the average number of weeks worked a year (in the current job).

It is also worth discussing why some information, although available from IFLS were not included or taken into account:

Income Respondents were asked about their labour income: whether salary or profits. First, respondents could mention their weekly or yearly, gross or net, salary or profit. It was unfortunately not possible to retrieve detailed information on taxation to know the relationship between net and gross income and hence to use such information. Second,

only around half of the respondents provided such information, which represent to few datapoints to construct an indicator of income.

Second job Although some respondents mentioned working two jobs, and further details were available on these second jobs, it was decided to focus on the primary activity and therefore not discuss second job.

4.3 Samples

The initial set of possible covariates included, for each region and each year:

- gender (share of males)
- average age
- share of individuals who attended junior high school
- share of individuals who attended junior high school
- average number of weeks worked per year
- average number of hours worked a week
- share of married individuals
- number of workers in the agricultural field
- number of workers in the manufacturing field
- share and number of informal workers
- share and number of non-governmental workers

The two outcomes of interest are:

1. the level of employment, i.e. the number of non-governmental *employed* workers. Informal workers being underrepresented in the public sector, it was decided to focus on non-governmental workers only.
2. the share of informal workers among the employed non-governmental workers. The objective is to discuss whether the share of informal workers expands or shrinks after the minimum wage is increased.

These two outcomes are evaluated first for the general population, and then for workers aged less than 30 years old.

The objective of this thesis is to analyse the minimum wage impact on employment participation, in general and in both the formal and informal sectors. With the level of employment and the share of informal workers, it is easy to induce information about the formal sector.

As it is common in the literature, for each year, all individuals above 15 years old are included. Then, aggregates are constructed by taking the average or counting the number of individuals satisfying specific criteria.[17] For instance, the share of males is the average of a dummy taking the value 1 if the individual is male or 0 if the individual is female, for all individuals aged 15 or more during the year of question.

The final samples includes all individuals aged 15 or more from nine regions, whose province of residence and the working status are known:

- Individuals who moved between two waves of IFLS were removed from the sample as it was impossible to know exactly when they moved and hence in which province they lived between the two waves
- Individuals who did not mention whether they benefited from any social coverage from their employment or not were also removed from the final sample
- Out of the fourteen regions surveyed by IFLS, four were not suitable donors as they implemented a new minimum wage policy before 2001, and one counted too few observations.

Table 1 shows the size of the final sample for each year and for each province of residence. Between the two more recent waves (2000 and 2007) several individuals changed their province of residence, resulting in a drop of the number of observations between 2000 and 2001.

In the following section, two samples will be considered: one to evaluate the minimum wage impact on the whole labour market, all individuals above 15, and the second to discuss the minimum wage impact on the youngest workers, aged more than 15 but less than 30. It is indeed often thought that younger workers, like women (International Labour Organization 2008b), are more affected by changes in the minimum wage, most probably because they tend to be on the lower tail of the wage distribution.

[17] Aggregates are constructed over the whole sample, i.e. all individuals aged more than 15 in the first sample and individuals between 15 and 30 in the second sample

Region	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
West Sumatra	1765	1736	1817	1894	2003	1798	1763	1810	1240	1277	1306	1340	1373	1404	1448
North Sumatra	2442	2250	2362	2474	2604	2377	2311	2436	1718	1765	1803	1853	1917	1974	2048
South Sumatra	1736	1619	1688	1773	1887	1753	1704	1798	1129	1166	1206	1238	1271	1303	1379
Lampung	1328	1311	1368	1428	1523	1396	1360	1421	1065	1100	1125	1153	1181	1213	1274
West Java	5156	5070	5299	5521	6106	5624	5511	6063	3592	3667	3744	3835	3946	4038	4464
Central Java	4141	4062	4232	4407	4724	4284	4203	4411	3148	3210	3272	3346	3415	3496	3687
East Java	4565	4462	4623	4840	5054	4817	4707	4963	3698	3781	3856	3942	4025	4114	4332
Yogyyakarta	2051	1983	2049	2121	2219	1977	1936	2032	1463	1486	1515	1549	1583	1615	1692
West Nusa Tenggara (NTB)	1880	1891	1978	2080	2194	2030	1978	2036	1565	1623	1677	1737	1797	1853	1911
Total	25064	24384	25416	26538	28314	26056	25473	26970	18618	19075	19504	19993	20508	21010	22235

Table 1: Total population of the final sample aged 15 or more, by year and province

Notes: This table shows the number of individuals in the final sample, i.e. the population over which aggregates were computed. It includes all individuals more than 15 years old who have not moved between two waves of IFLS survey and whose social coverage status is known.

5 Results

5.1 Impact on the whole labour market

Impact on the employment level

As explained in section 3, the synthetic control is constructed attributing a weight to each potential donor, such that the difference between the outcome of interest, here the employment level, for the treated region and the synthetic control is minimized during the preintervention period, for a given set of controls. [18] Table 2 shows the weights attributed to the eight regions composing the donors pool.

Region	Weight
North Sumatra	0.021
South Sumatra	0.629
Lampung	0.183
West Java	–
Central Java	–
East Java	–
Yogyyakarta	0.139
West Nusa Tenggara (NTB)	0.028

Table 2: Weighting scheme of the synthetic control group (employment level, all non-governmental workers)

Although the initial set of explanatory variables is the one presented in section 4, it is not recommended to systematically include all of them, but rather to find a set of covariates that minimizes the MSPE pre-intervention (Abadie et al. 2010). It is also recommended to include lagged effects (Abadie et al. 2010, Neumark & Wascher 1994). First because the set of explanatory covariates is averaged over the preintervention period and second, because employment effects are not immediate, including lagged variables increases the model's robustness in time.

After testing several combinations of covariates and lagged employment levels, the one that minimizes the MSPE represent gender (share of males), education (share that attended senior high school), marital status (share of married individuals), age (average age), industry (number of non-governmental workers in agriculture and manufacturing), labor intensive margin (number

[18] Hainmueller J, Abadie A, and Diamond A, developed *synth*, a statistical software that implements synthetic control methods for causal inference in comparative case studies. This software determines the best weighting scheme and predict the outcome of interest in the synthetic control. All results presented in this section are computed using the Stata version of this programme.

of hours worked a week and number of weeks worked a year) region's size (total population aged 15 or more), and lagged employment level (number of non-governmental workers in 1993).

With the synthetic method, explanatory variables are usually averaged over the pre-intervention period. Table 3 displays the average of the predictors in West Sumatra as well as in the synthetic counterfactual, which is the average of the predictors in the donor pool weighted according to the weighting scheme displayed in table 2.

One way to ensure that the synthetic control is an accurate mirror of the treatment unit is to compare the true and the synthetic values of the predictors. Table 3 shows that the synthetic values of the predictors means are very close to the true ones, with only small differences in the number of non-governmental workers, in general and by industry, and in the proportion of married individuals. The differences between the true and the synthetic values are insignificant, which shows that the synthetic control method is suitable for this thesis.

	West Sumatra	
Variable	Real value	Synthetic value
Share of males	0.485	0.495
Share that attended senior high	0.096	0.105
Share of married individuals	0.576	0.607
Mean age	36.513	36.607
Number of non-governmental workers (1993)	583.000	578.025
Number of manufacturing workers	413.250	431.288
Number of agricultural workers	413.250	437.715
Number of weeks worked in a year	41.080	39.226
Number of hours worked per week	42.803	39.552
Total population	1769.125	1689.169

Notes: This table shows the means of the explanatory variables in West Sumatra and for the synthetic counterfactual. All variables are averaged over the preintervention period (1993-2001) except the number of weeks and hours worked (averaged over 1993-2000) and the number of non-governmental workers in 1993

Table 3: Predictors mean (employment level, all non-governmental workers)

Table 4 shows the means of the explanatory variables for each potential donors as well as their weighted average.[19] It shows that taking the weighted average over all potential donors does not provide a counterfactual as good as the synthetic control. Indeed, the difference between the weighted average of the predictors displayed in table 4 and the predictors means for West Sumatra displayed in table 3 tend to be larger than the difference between West Sumatra and the synthetic control. For instance the number of weeks worked per year is much larger when taking the weighted average of all potential donors (49.455) than with the synthetic control (39.226)

[19] Averaged over all potential donors weighted by population.

Region	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
West Sumatra	1765	1736	1817	1894	2003	1798	1763	1810	1240	1277	1306	1340	1373	1404	1448
North Sumatra	2442	2250	2362	2474	2604	2377	2311	2436	1718	1765	1803	1853	1917	1974	2048
South Sumatra	1736	1619	1688	1773	1887	1753	1704	1798	1129	1166	1206	1238	1271	1303	1379
Lampung	1328	1311	1368	1428	1523	1396	1360	1421	1065	1100	1125	1153	1181	1213	1274
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West Nusa Tenggara (NTB)	1880	1891	1978	2080	2194	2030	1978	2036	1565	1623	1677	1737	1797	1853	1911
Total	25064	24384	25416	26538	28314	26056	25473	26970	18618	19075	19504	19993	20508	21010	22235

Table 1: Total population of the final sample aged 15 or more, by year and province

Notes: This table shows the number of individuals in the final sample, i.e. the population over which aggregates were computed. It includes all individuals more than 15 years old who have not moved between two waves of IFLS survey and whose social coverage status is known.

or in West Sumatra (41.080). It shows that the synthetic control is a better counterfactual than a simple average of potential donors.

Once, the synthetic control is constructed, the treatment effect, the difference between the outcome in the treated region and the synthetic control after the initial intervention period, can be evaluated. Figure 3 shows the trajectory of the employment level among non-governmental workers between 1993 and 2007 for both West Sumatra and the synthetic control.

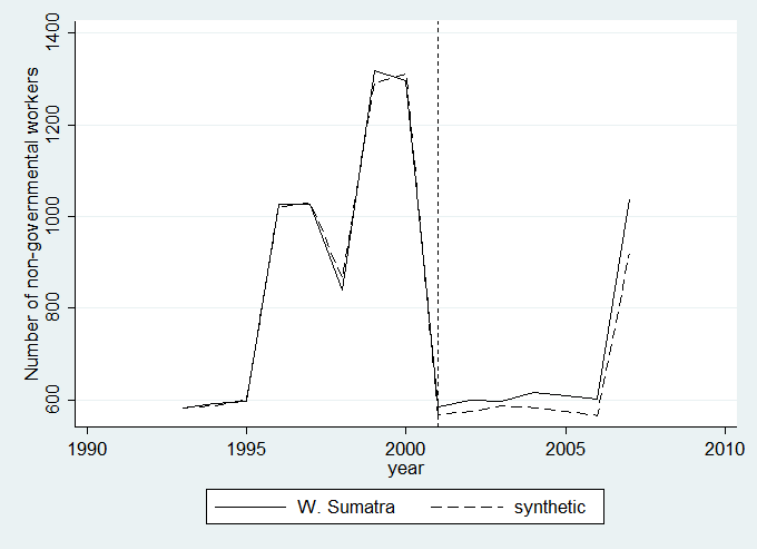

Figure 3: Level of employment (all non-governmental workers): West Sumatra vs synthetic control

Notes: The dashed line represents the intervention period (2001)

First, it visually confirms that the synthetic control is a good counterfactual for the treated region as the trajectory of the synthetic employment level almost perfectly fits the employment level of West Sumatra before 2001. Second, it shows that the 2001 minimum wage increase in West Sumatra did not have any significant impact on the employment level in the region as there is no difference between the number of employed non-governmental workers in the treated and control region. The significant decrease in employment between 2000 and 2001, both in West Sumatra and in the synthetic control, can be explained by the number of observations that had to be removed from the sample between 2000 and 2001[20] and not by a real change in

[20] As explained in the previous section, several individuals changed their province of residence between 2000 and 2007 and had to be removed from the sample, resulting in a drop of the number of observations between 2000 and 2001

the labor market.

These results were robust to different set of predictors: for instance including the employment level of 1996 or 1997, or two past levels of employment, or removing the number of hours worked, or the number of agricultural workers, etc. made the prediction only slightly worse (increasing the RMSPE from 19.416 to 22.014 at most).

Effect on the informal sector

To evaluate the impact of the increase of the minimum wage on the informal sector, the synthetic control method is applied to the same sample, i.e. all individuals aged more than 15 years old, with a different outcome of interest: the proportion of informal workers among the employed non-governmental workers. Indeed, the regions and the variables that are optimal to predict one outcome might not be optimal to predict a different outcome. Table 5 shows the weighting structure of the synthetic control.

Region	Weight
North Sumatra	0.394
South Sumatra	0.142
Lampung	0.102
West Java	–
Central Java	–
East Java	–
Yogyyakarta	–
West Nusa Tenggara (NTB)	0.362

Table 5: Weighting scheme of the synthetic control group (share of informal workers, all non-governmental workers)

The optimal set of predictors includes indicators of gender (share of males), education (share that attended senior high school), marital status (share of married individuals), age (average age) and the share of informal workers in 1993 and 1996. Table 6 shows the mean of the predictors for the treated region and the synthetic control. As the sample is the same, the predictors' means in West Sumatra are the same than in table 3. On the other hand, as the set of regions used to construct the synthetic control has changed, the synthetic values of the predictors' means might have changed. With very small differences between the *true* and synthetic values of the predictors' means, table 6 shows that the synthetic control mirrors well the treated region.

Variable	West Sumatra	
	Real value	Synthetic value
Share of males	0.485	0.479
Share that attended senior high	0.096	0.098
Share of married individuals	0.576	0.585
Mean age	36.513	36.626
Share of informal workers (1993)	0.965	0.962
Share of informal workers (1996)	0.953	0.953

Notes: This table shows the means of the explanatory variables in West Sumatra and for the synthetic counterfactual. All variables but the shares of informal workers in 1993 and 1996 are averaged over the preintervention period (1993-2001)

Table 6: Predictors mean (share of informal workers, all non-governmental workers)

Figure 4 plots the share of informal workers (among employed non-governmental workers) for the period 1993-2007 for both West Sumatra and the synthetic control. It confirms that the synthetic control is a good counterfactual for the treated region: even with small differences, the trajectory of the synthetic control is a good fit for the treated unit in the preintervention period (the RMSPE in this case is 0.0035, or 0.35%). It also shows that the increase in minimum wage seems to have an impact on the informal employment as the share of informal workers was 1.2 % lower in West Sumatra than in the synthetic control is 2002 and 6.2 % lower in 2007. This seems to be a significant effect: the gap between the synthetic control and West Sumatra increased by 5 percentage point or more than quadrupled within the five years following the intervention. However, before reaching any conclusion, it is necessary to run placebo tests to ensure that this difference is really due to the increase in minimum wage and not some measurement errors.

As suggested by Abadie et al. (2010), the synthetic control method was applied to all the untreated regions (potential donors). It means that I considered each potential donor as the *treated* unit and I evaluated whether a treatment effect can be measured in any of these placebo tests.

The objective is to discuss whether the results were really driven by the increase of minimum wage or by chance. If the placebo tests show a treatment of similar magnitude, i.e. if the difference in outcome – here the share of informal workers among the employed non-governmental workers – is similar to the one found in West Sumatra, it would mean that the results are not significant. On the other hand, if the outcome gap is unusually large for the treated region, it would suggest that the increase in minimum wage significantly reduced the share of informal workers in West Sumatra.

Figure 5 shows the results of these placebo tests – the difference in the share of informal

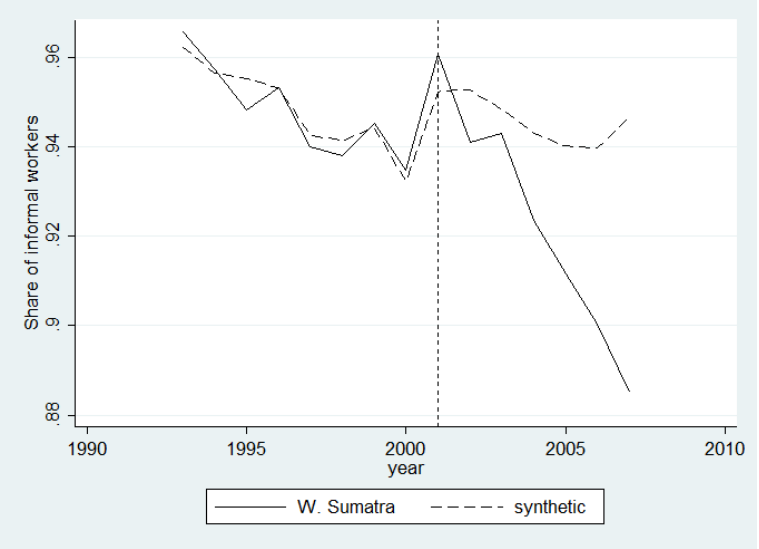

Figure 4: Share of informal workers (among all non-governmental workers): West Sumatra vs synthetic control

Notes: The dashed line represents the intervention period (2001)

workers between the *treated* region and the synthetic controls for all placebo tests. The black lines represent the outcome gaps for all of the 9 regions of the donors pool and the green line the outcome gap for West Sumatra. Although the outcome gap seems larger for West Sumatra, or at least the share of informal workers seems to decrease more steadily after the intervention, it is difficult to infer any results from figure 5 as the placebo synthetic controls do not necessarily mirror the true outcome trajectory for the *placebo treated units*. Indeed, the outcome gap is relatively large in the preintervention period for several placebo tests and it is therefore impossible to discuss any effect – if the synthetic control is not a good counterfactual, no conclusions can be derived from the studies.

Figure 6 displays the results of the placebo studies for the regions with a RMSPE less than four times higher than West Sumatra's. In other words, for the regions for which the synthetic control provides a better counterfactual. It shows that the outcome gap in West Sumatra is significantly larger than in the other regions, with the exception of East Java (lowest black line). However, the difference between the share of informal workers in the synthetic control of in East Java is always relatively large, even in the preintervention period and it does not seem to increase after the intervention. It therefore does not demonstrate that the effect measured

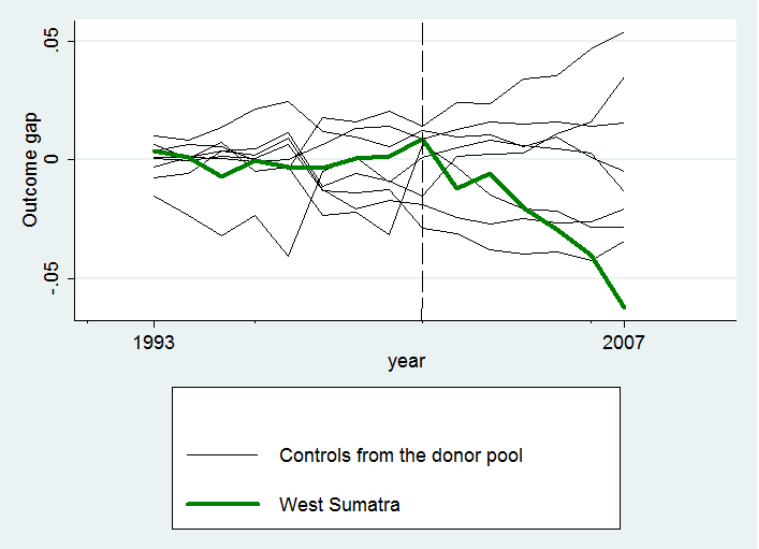

Figure 5: Share of informal workers gap, West Sumatra and all potential donors

Notes: This figures represent the outcome gaps – difference between the share of informal workers in the true region and its synthetic counterfactual – for West Sumatra and each placebo test, i.e. considering each region as the *treated* region.
The dashed line represents the intervention period (2001)

for West Sumatra was the result of *luck* only.

Figure 7 displays the results of the placebo studies for the regions with a RMSPE less than three times higher than West Sumatra's. It is then clear that the trajectory of the share of informal workers in West Sumatra is unusual and that the gap between the true and the synthetic outcomes is significantly larger in this region.

Robustness and inference

The above mentioned placebo tests seem to suggest that the effect measured on the share of informal workers can be attributed the increase in minimum wage. As the model was optimized for West Sumatra, the set of predictors used was selected as it minimized the MSPE for this particular region. Hence, it could be argued that the placebo tests are invalid as a different set of predictors should have been chosen for each placebo test. I therefore re-applied the same procedure with different sets of predictors. Figures 8 and 9 show the results of placebo test when I added the number of manufacturing workers in the predictors and changed the lagged variables

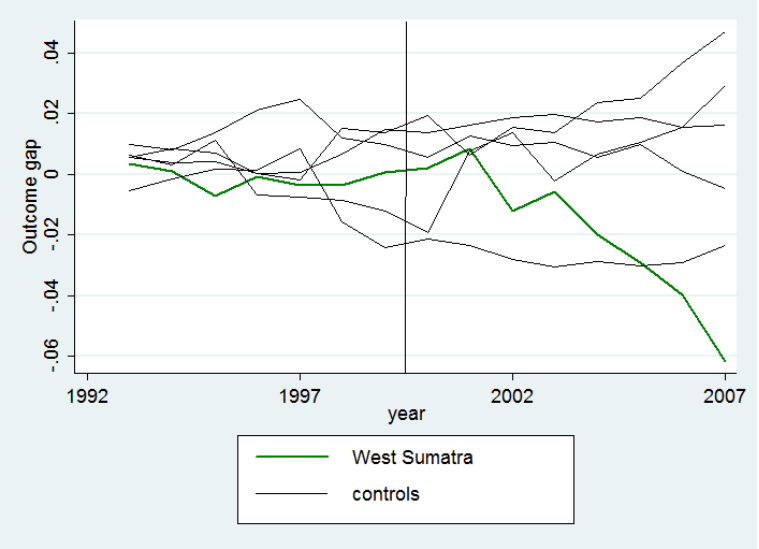

Figure 6: Gap in the share of informal workers, West Sumatra and potential donors (discard regions with preintervention MSPE four times higher than West Sumatra)

Notes: This figures represent the outcome gaps – difference between the share of informal workers in the true region and its synthetic counterfactual – for West Sumatra and the *good* placebo test, i.e. the placebo tests which predicts the preintervention outcome with a relatively small error (not higher than four times West Sumatra's).
The vertical line represents the intervention period (2001)

for the share informal workers in 1994 and 1999. The outcome gap for West Sumatra is very close to 0 pre-intervention, which confirms that this new set of predictors also provides a good counterfactual for my region of interest. Figure 8 also shows a increasing gap post-intervention which reflects a treatment effect. Figure 9, which only shows the alternative placebo tests for the regions with the smaller preintervention MSPE – no larger than three times higher than West Sumatra – confirms that the measured effect is due to the intervention. This test confirms that the minimum wage increase in West Sumatra reduced the share of non-governmental workers employed in the informal sector.

This study suggests that the 2001 increase in minimum wage in West Sumatra did not significantly change the level of employment of non-governmental workers but resulted in a shift from the informal to the formal sector. These results are in line with the theory: i) workers in Indonesia were paid less than their marginal productivity before 2001 (International Labour Organization 2008b) so, even after the increase in minimum wage, firms' do not have strong incentive to reduce their workforce, hence the total level of employment remains unchanged; and ii) with higher minimum wages, the formal sector become more attractive and informal

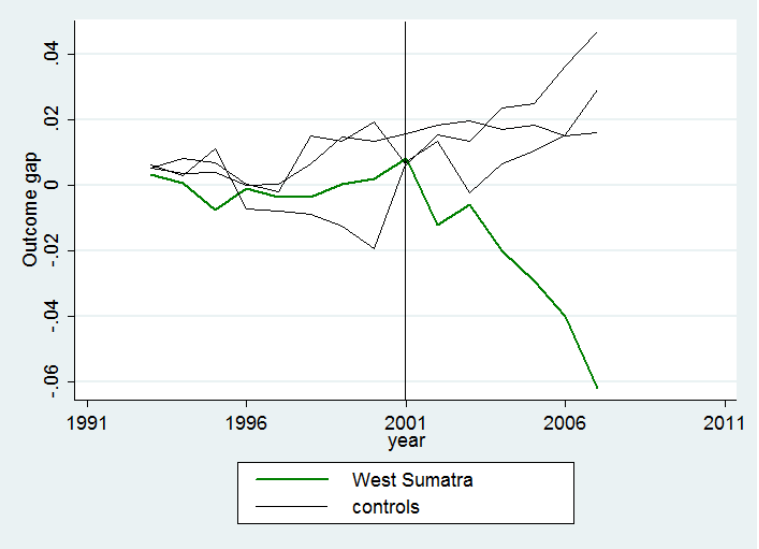

Figure 7: Share of informal workers gap, West Sumatra and potential donors (discard regions with preintervention MSPE three times higher than West Sumatra)

Notes: This figures represent the outcome gaps – difference between the share of informal workers in the true region and its synthetic counterfactual – for West Sumatra and the *best* placebo test, i.e. the placebo tests which predicts the preintervention outcome with the smallest error (not higher than three times West Sumatra's).
The vertical line represents the intervention period (2001)

workers might follow the path towards formality.

These findings contradicts Comola and de Mallo's analysis (Comola & De Mello 2011) but there are two main difference between our models. First, as they argued, the minimum wage increased successively between 2001 and 2004, and at an higher rate than the value added per employee. As a result, the difference between minimum wage and marginal productivity was lower in 2004 than in 2001 and firms' incentive to destroy jobs (at least in the formal sector) was higher. Second, we did not use the same definition of informal workers. As they used data from the national labour force survey and did not have information on social coverage, they defined informal workers as "*all self-employed, employers or family/unpaid workers*" (Comola & De Mello 2011). Consequently, they estimated that 70% of Indonesian workers were in the informal sector. With the definition I used, I found that in 2000, 86 % of employed Indonesian worked in the informal sector if the governmental sector is included. My estimation seems in line with the International Labor Organization which estimated that only 18% of the whole Indonesian population was covered in 2008 (International Labour Organization 2008b).

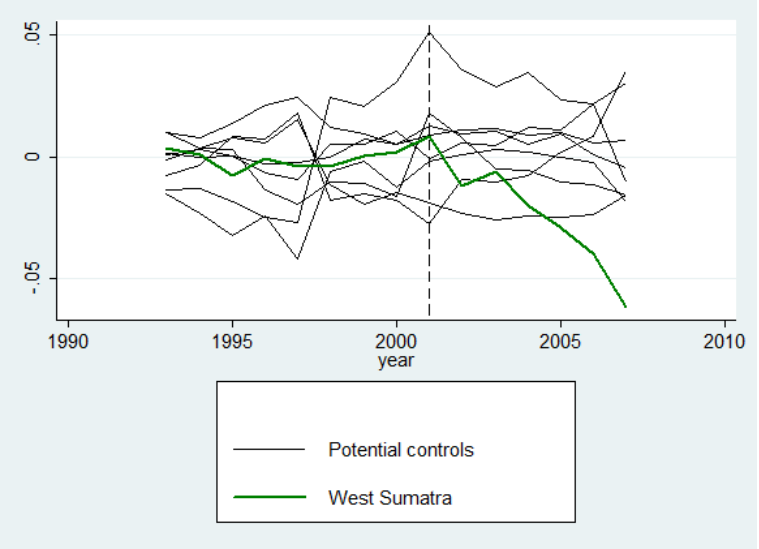

Figure 8: Alternative placebo test: share of informal workers gap, West Sumatra and potential donors

Notes: This figures represent the outcome gaps – difference between the share of informal workers in the true region and its synthetic counterfactual – for West Sumatra and the *best* placebo test, i.e. the placebo tests which predicts the preintervention outcome with a relatively small error.
The dashed line represents the intervention period (2001)

Finally, even if my final sample include more than 20'000 individuals, which is a relatively large sample, it only includes a little more than 1'400 individuals residing in West Sumatra for the year 2007. Although IFLS is supposed to be representative of 83% of the Indonesian population (RAND), inferring definitive results on a little more than 1'400 individuals may be hasty.

5.2 Impact on youth employment

Impact on employment level

Given that the literature reaches the general agreement that the employment of young workers (and women) is more sensitive to minimum wages (see for instance Neumark & Wascher 1992 or Abowd et al. 1997), I decided to analyze the impact of the minimum wage increase among young workers. To do so, I applied the synthetic control method to a new sample which includes

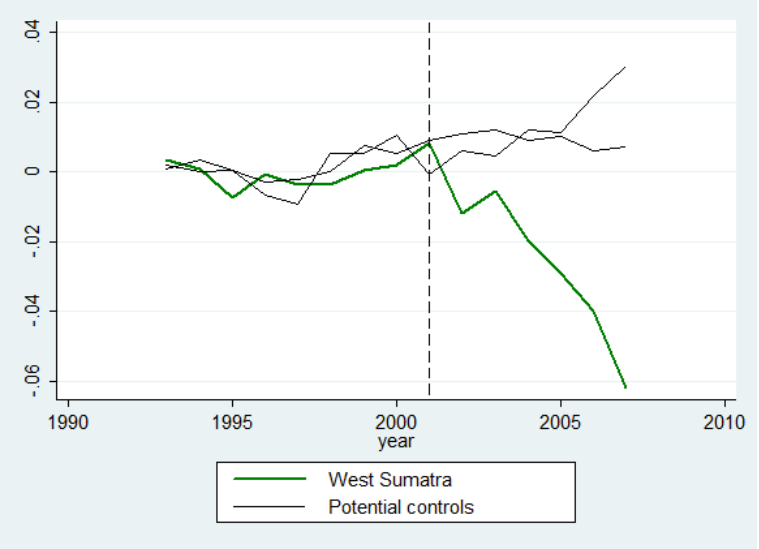

Figure 9: Alternative placebo test: share of informal workers gap, West Sumatra and potential donors (discard regions with preintervention MSPSE three times higher than West Sumatra)
Notes: The dashed line represents the intervention period (2001)

all individuals between 15 and 30 years old.

Region	Weight
North Sumatra	0.195
South Sumatra	0.633
Lampung	0.172
West Java	–
Central Java	–
East Java	–
Yogyyakarta	–
West Nusa Tenggara (NTB)	–

Table 7: Weighting scheme of the synthetic control group (employment level, workers aged 30 or less)

Table 7 shows the weights attributed to the eight donors in the potential donors pool. For this sample, the optimal set of predictors include indicators of education (proportion that attended senior high school), gender (share of male), region size (total population) and information on the labour market itself (number of young non-governmental workers in the agricultural field and employment level non-governmental workers aged 30 or less in 1997). Table 8 shows the predictors means for West Sumatra and the synthetic control and, with very small difference in

Variable	West Sumatra	
	Real value	Synthetic value
Share that attended senior high	0.0774	0.0793
Share of males	0.4759	0.4987
Population size	781	757.334
Number of agricultural workers	136.875	142.9548
Number of non-governmental workers (1997)	358	369.83

Notes: All variables but the number of non-governmental workers in 1997 are averaged over the preintervention period (1993-2000)

Table 8: Predictors mean (employment level, non-governmental workers aged 30 or less)

predictor means, it shows that the synthetic control mirrors well the treated region.

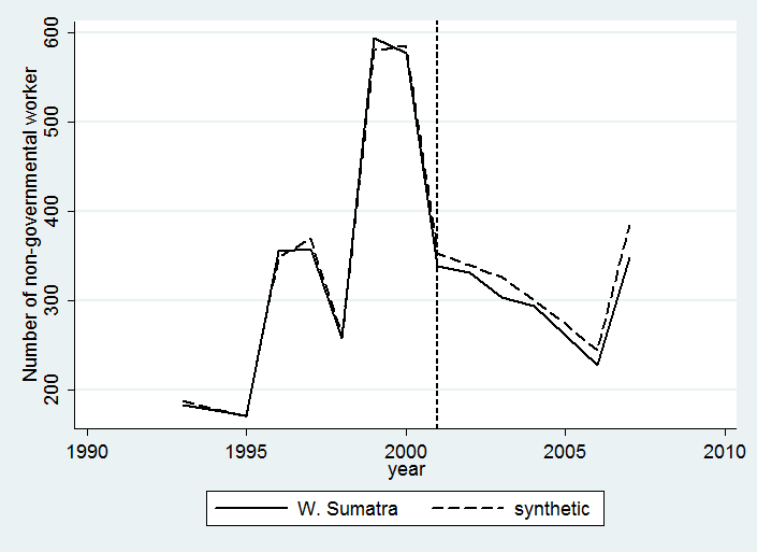

Figure 10: Level of employment (non-governmental workers aged 30 or less): West Sumatra vs synthetic control

Notes: The dashed line represents the intervention period (2001)

Figure 10 shows the trajectory of the employment level among non-governmental workers aged 30 or less between 1993 and 2007 for both West Sumatra and the synthetic control. It visually confirms that the synthetic control is a good counterfactual for the treated region as the trajectory of the trajectory of employment level almost perfectly fits the employment level of West Sumatra before 2001. Second, it shows that the 2001 minimum wage increase in West Sumatra did not have any significant impact on the employment level in the region as there is no difference between the number of employed non-governmental workers aged 30 or less in the

treated and control region.

As explained earlier, the significant decrease in employment between 2000 and 2001, both in West Sumatra and in the synthetic control, can be explained by the number of observations that had to be removed from the sample between 2000 and 2001 (cf. section 4) and not by a real change in the labor market.

These results were robust to different set of predictors: for instance including the number of non-governmental workers in manufacturing industries, or the employment level for 2000 almost did not change the MSPE (from 7.82 to 9.9 at most). Including marital status, and/or age, and/or the proportion that attended junior high school instead of senior high school, and/or chosing different year for the lagged variable (1993, 1996, 2000) still provided a relatively good counterfactual fit (increasing the RMPSE to 12.51 at most).

Impact on the share of informal workers

Region	Weight
North Sumatra	–
South Sumatra	0.883
Lampung	0.001
West Java	0.107
Central Java	–
East Java	–
Yogyyakarta	–
West Nusa Tenggara (NTB)	–

Table 9: Weighting scheme of the synthetic control group (share of informal workers, non-governmental workers aged 30 or less)

Table 9 shows the weights attributed to the eight donors in the potential donors pool. For this sample, the optimal set of predictors include indicators of education (proportion that attended senior high school), gender (share of male), and information on the labour market itself (number of young non-governmental workers in the agricultural field and share of informal workers in 1994 and 2000). Table 10 shows the predictors' means for West Sumatra and the synthetic control. As the sample used to measure the minimum wage impact on the share of informal workers is the same as the one used to measure the impact on employment level, the values of the predictors' means in West Sumatra are the same as those displayed in table 8. On the other hand, the regions used to construct the synthetic group are different, resulting in different means in the virtual control group. The predictors' means of the synthetic counterfactual are

Variable	West Sumatra	
	Real value	Synthetic value
Share that attended senior high	0.0774	0.0809
Share of males	0.4759	0.4984
Number of agricultural workers	136.875	179.991
Share of informal workers (1994)	0.9706	0.9705
Share of informal workers (2000)	0.9302	0.9340

Table 10: Predictors mean (share of informal workers, non-governmental workers aged 30 or less)

Notes: All variables but the shares of informal workers in 1994 and 2000 are averaged over the preintervention period (1993-2000)

relatively close to the true means, in West Sumatra, except for the number agricultural workers. However, even with such differences, the RMSPE is relatively small, around 0.0074, which seems to indicate a relatively good fit.

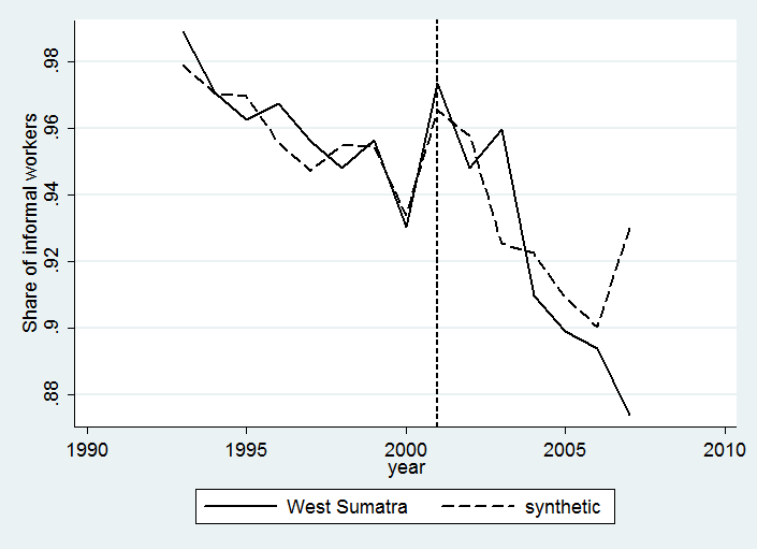

Figure 11: Share of informal workers (non-governmental workers aged 30 or less): West Sumatra vs synthetic control

Notes: The dashed line represents the intervention period (2001)

Figure 11 shows the share of informal workers among employed non-governmental workers aged 30 or less between 1993 and 2007 for both West Sumatra and the synthetic control. It

visually confirms that the synthetic control is a good counterfactual for the treated region as the trajectory of the share of informal non-governmental workers provides a good fit of the outcome of interest for West Sumatra before 2001. The differences in trajectory seem relatively small, which is confirmed by the small RMPSE (0.0074). Second, it shows that the 2001 minimum wage increase in West Sumatra did not have any significant impact on the share of informal workers among employed non-governmental workers aged 30 or less. Indeed, there is not difference between the outcome of interest in West Sumatra and in the synthetic control post-intervention.

It should be emphasized that these results were slightly more sensitive to the set of predictors than the previous estimations. Moreover, table 8 shows larger differences in the predictor means than my previous estimations; and the RMSPE is more than twice than the one obtained when estimating the minimum wage impact on the share of informal workers among all non-governmental workers (0.0074 against 0.0035). Also the synthetic control method seems applicable in this setting, further tests, or using a different approach might be useful.

5.3 Possible limits of the model

The model presented in this thesis is inadequate if one of the main assumptions does not hold. First, the intervention should not have any impact on the treated region prior to the initial intervention period. It means that the effect of the new minimum wage policy should not have had any impact before 2000.[21] Given that the Indonesian government announced its willingness to increase the minimum wage in 2000, such scenario seems unrealistic. One could argue that some agents would expect an imminent increase in minimum wage and hence start adapting their behaviour accordingly. This also seems unlikely as firms do not have any reason to increase their wage before they are legally forced to, and workers would not change their behaviour towards job before the new minimum wage is implemented. Even in such a case, the treatment effect measured in the precedent section would only be underestimated as the effect would have started in the pre-treatment period.

Second, the treatment should not have any impact on any of the control regions.

One case of externality would be that the policy changed the labour market of other regions, most likely neighbouring regions. Data on North Sumatra[22] does not reflect any major changes.

[21] With yearly data, any change happening in the middle of 2000 would not be captured before the initial intervention period.

[22] North Sumatra is one of the four regions with which West Sumatra shares a border, and the only one included in IFLS.

The number of non-governmental workers decreases in North Sumatra between 1999 and 2002, but this is solely due to a decrease of the number of observations. The share of non-governmental workers among all individuals aged 15 or more remains relatively unchanged during this period. As for the share of informal workers among these non-governmental workers, it slightly increased between 1999 and 2002 (by less than 2%) but goes back to its 1999 level. Hence, it seems that the change in West Sumatra's labour standards had no or very little impact on North Sumatra's labour market.

Another case of externality would be an unusual migration of workers from (or to) the treated region. The data does not reflect any definitive migration, i.e. the volume of individuals moving away from West Sumatra, or to West Sumatra, remained relatively stable between 1997-2000 and 2000-2007.

Workers could also daily commute to go and work in the region across the border of their province of residence. As the data does not include information on where the worker does work, it would be possible that residents of West Sumatra daily commute to frontier regions. It would explain that the level of employment remains unchanged – the same number of residents are working, even if their job is in a different region. It could also explain the drop in the proportion of informal workers: with a higher minimum wage in the neighbour region, North Sumatra's firms have a competitive advantage which could result in an increase in their demand in formal labour. However, the effect measured seems too large to be explained by this daily commutes. Moreover, if North Sumatra had such a large comparative advantage, employment conditions of its own residents should also be affected – but the data does not reflect any increase in employment or any major or any shift between the formal and informal sectors.

Another common source of improper causal attribution is endogeneity, which would happen if the increase in minimum wage is (at least partially) explained by the change in labour market conditions. Here, it would mean that West Sumatra adapted to the formalization of its labour market by increasing the minimum wage, or that both the reduction of informality and the minimum wage increase are the result of a third factor.

However, the 2001 minimum wage followed a governmental directive aiming at correcting the labour market as the minimum wage did not grow as fast as labour productivity and did not reflect economic growth. If the increase in minimum wage would be endogenous, it should have better reflected the changes in the labour market conditions, while it is here solely the result of an exogenous political decision.[23] It is therefore safe to assume that the changes in the

[23]If the formalization of the workforce had resulted in an increase of the minimum wage, it would mean that workers' bargaining power had increased, most likely because the formal sector would be better organized and workers better represented. Consequently, the minimum wage growth should have been aligned on the gain in

proportion of informal workers did not have any direct impact on the minimum wage.

Finally, the placebo tests run with the synthetic control of method might not be perfect. It could be argued that the set of predictors should be optimized for every control to confirm that the measured treatment effect is significant. Nonetheless, and as explain in the section 4, I have applied the synthetic method with three different sets of predictors and reached similar results. And even though the sets minimize the MSPE for West Sumatra, and not for each region, figure 7 shows that they provide a good counterfactual for one third of the control regions, which seems to confirm the significance of the measured treatment effect.

A more general limit of the method proposed by Abadie et. al (2010), is how to decide whether the method is relevant. They argue that the difference between the outcome of interest in the synthetic control and in the treated region should be small but it is up to the researcher to interpret whether the synthetic control provides a good counterfactual or not. Similarly, it is more difficult to interpret the treatment effect with this method as the significance levels generally used in the literature do not apply here: it is up to the researcher to interpret the magnitude of the difference of the outcome of interest in the treated unit and the synthetic control.

marginal productivity, which was not the case in Indonesia.

6 Conclusion

Using the synthetic control method developed by Abadie et al (Abadie et al. 2010), I found that the increase in minimum wage implemented by West Sumatra in 2001 resulted in a shift from informal to formal employment: without affecting the level of employment, the share of informal workers was 6% less in 2007, five years after the intervention, than it would have been without the new minimum wage.

It confirms that informal workers choose informality because outside options are less attractive and that, when made more attractive, they would choose the outside option, here working in the formal sector with a higher minimum wage. Of course, this can only be true as long as the marginal productivity of labour remains higher that the minimum wage and hence as long as the new minimum wage does not have any strong impact on the labour demand.

I also found that the increase in minimum wage did not have any significant impact on the employment of young workers (less than 30 years old). This suggests that young workers are more likely to find jobs in the informal sector and that their work is driven by the lack of other options rather by their own preference.

Further research would be required to have a complete picture on how minimum wage impacts on labour market.

Firstly, and as pointed out in section 5, the final sample covers a little more than 1'400 individuals in West Sumatra. Although IFLS is supposed to be representative of the 83% of the Indonesian population (RAND), further studies in a larger sample might be required to confirm my results.

Secondly, even if the participation rate does not evolve, the total effect on labour market also depends on the intensive margin. Indeed, it may appear that the level of employment has not been affected but, as a matter of fact, individuals tend to work less, which means that the input in labour has been affected by the increase of the minimum wage.

Finally, some studies pointed out that an increase in minimum wage has a strong impact on the labour market repartition between small and large firms (see for instance Ham 2013, Del Carpio et al. 2012, Rama 2001). Large firms being more likely to offer formal jobs, my result might reflect a shift from small to large firms more than a general shift from informal to formal sector.

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