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WORKING PAPER

Inequality and Property Rights, Revisited

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Inequality and property rights revisited*

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Abstract

While the importance of institutions for growth and development has been firmly established, empirical assessments of their effect on income distributions remain largely inconclusive. In this study we revisit this issue, looking in particular at how property rights affect inequality. To this end, we use a state-space model to combine all available indicators tracking the protection of property rights into an index that covers 190 countries over the period 1994-2014. Using dynamic panel estimations based on the GMM-system and the X-differencing techniques, we find that increases in property rights translate into a worsening of distributional outcome. In line with existing studies, we find no strong evidence to show that democracy exerts an independent, direct effect on net income inequality. However, the estimated coefficient of the interaction term between property rights and democracy is negative and statistically significant; thus suggesting that in high democracies, property rights significantly decrease net-income inequality. These effects effects seem to play through the government's redistribution as market-income inequality is not affected by property rights, democracy or their interaction. Our findings remain robust to specification, methodology, data structure and sample changes.

JEL Codes: O15; O17; D70
Keywords: Inequality; Property rights; Institutions; Dynamic panel; State-space model

1 Introduction

Although it has long been accepted that the distribution of assets and income generated by a market depend largely on the political system under which it operates, little attention has been devoted to the distributional effects of institutions. Indeed, much of the literature on the role of institutions, broadly speaking, has been devoted into understanding their

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impacts on economic development and growth (see Acemoglu et al., 2002; Barro, 1996; Gould and Gruben, 1996; Hall and Jones, 1999; Helliwell, 1994; Knack and Keefer, 1995; Przeworski et al., 1995; Rodrik et al., 2004, among others). In recent decades, however, a growing number of studies in social sciences have started to explore the impact of institutions on inequality.

Several arguments are generally put forward in explaining how institutions affect inequality. One view, which has its foundation on the median voter model (see Meltzer and Richard, 1981), maintains that the link between market generated inequality and redistribution is higher in democracies than in autocracies. Secondly, Acemoglu et al. (2013) argued that by allowing the poor to share the political power of their society, good institutions (democracies) put pressure on governments to implement redistributive measures which reduces inequality. Along the same line, Amendola et al. (2013) note that as institutions shape economic and political processes, they affect citizens' incentives as well as the constraints they face in participating in a wide range of activities. As a result, they are likely to have a significant effect on income distribution. This view is shared by Knight (1992) who argues that institutions affect the rules and social norms that shape agents' behaviour, structuring social interaction. Others have also claimed that the opportunity of participation increases in democracies which allows the poor to demand more equitable income distribution (see Chan, 1997; Boix, 1998; Bollen and Jackman, 1985).

Whilst at the theoretical level there seems to be a general consensus on the positive distributive effect of democracies ('good institutions') the empirical literature is far from conclusive. To be sure, some studies (see Muller, 1988; Moon, 1991; Rodrik, 1999; Li et al., 1998; Reuveny and Li, 2003; Chong and Gradstein, 2007) found that democracy tends to reduce inequality. For example, Rodrik (1999) reported evidence from a panel of countries showing that democracy is associated with high real wages and higher share of labour in national income. Reuveny and Li (2003) found evidence that democracy reduces inequality. In contrast, other studies have shown that democracy either has no effect on inequality or that it worsens it (see Sirowy and Inkeles, 1990; Lee, 2005; Acemoglu et al., 2013). Indeed, some recent studies have provided evidence that income inequality is growing in many of the world's most affluent democratic countries (Atkinson et al., 1995; Gottschalk and Smeeding, 1997; Birchfield and Crepaz, 1998; Gottschalk and Smeeding, 2000; Moene et al., 2002; Bradley et al., 2003; Mahler, 2004; Kenworthy and Pontusson, 2005; Iversen and Soskice, 2006).

In line with the literature above our study looks at the effect of institutions on inequality, but focuses specifically on the distributional effects of property rights.[1] As such, it is closely related to the work of Amendola et al. (2013) who found that strengthening property rights protection increase income inequality in developing countries. Similar conclusion is also reported by Carmignani (2009) for a sample of 120 countries and covers the period 1970-2000. Theoretically, the extent to which property rights affect inequality will depend on whose property rights are protected by the government. Along these lines, it has been argued that property rights can worsen income distribution if they are designed to perpetuate the interests of advantaged minorities. For example, Levi (1988) remarks that, revenue-maximising governments would tend to protect the rights of those who yield the highest return to their investment in property rights i.e. the middle class. This view is also shared by Sened (1997). The main argument puts forward by proponents of this view is that only the middle class has the incentive to create prosperity and wealth which are crucial for governments relying on tax revenues. In other words, whilst the

[1] Besley and Ghatak (2010) stress the importance of property rights.

protection of private property rights is a crucial instrument for governments to maximize their own utility, inequality will be an inevitable result of this process as Piketty (2013) has documented. Nonetheless if the extractive government uses the generated funds for redistributive purpose then inequality is likely to be reduced. For example, Besley and Persson (2013) posit that as property rights increase the cost of the informal economy, they make it easier for the government to tax and redistribute. This effect potentially interacts with democracy, as the latter influences the government's propensity to redistribute (Acemoglu et al., 2013). In other words, while the direct effect of property rights may increase inequality its indirect effect may reduce it. The property rights-inequality nexus is therefore an interesting empirical question to investigate.

Our empirical work differs from existing studies in a number of ways. First, we construct a new indicator on the protection of property rights that improves on the existing ones (e.g. the indexes published by Fraser Institute or the Heritage Foundation) both in terms of measurement accuracy as well as coverage. By combining all publicly available information on property rights we are able to increase the number of countries covered and limit the number of missing observations. Moreover, whereas most indicators take various aspects of the rule of law into account, our index is focused solely on the protection of property rights. This allows us to separate their effects on income distribution from that of other institutional changes. Our estimation framework controls for various empirical issues, including endogeneity, model uncertainty as well as the underlying uncertainty in the measurement of property rights.

The findings in this paper show that: (1) property rights increase net income inequality; (2) democracy has no direct effect on inequality; (3) but it does have a significant interaction with property rights, i.e. property rights reduce inequality in strong democracies; and finally (4) these effects run through the government's redistribution (taxes and transfers) as both property rights and democracy become insignificant when using market income inequality.

The paper proceeds as follows. In the next section we discuss the new property rights indicator as well the data used in the empirical exercise. Section 3 describes the methodology. Section 4 presents the findings, and Section 5 concludes.

2 Measuring property rights protection

As is the case with most indicators of governance, there is no hard data available that allows a cross-country comparison of the protection of property rights. Instead, the indicators most often used when studying (the effects of) property rights are perception-based, capturing the opinion of experts, business leaders, or people working for the government and multilateral organisations. Currently, there are a number of different indicators of property rights from various sources and two composite indexes that combine several of these indicators.

There are two main problems with the singular indicators of property rights. First, most indicators of property rights are only available for a small set of countries or years, making it hard to use them in time-series or panel data analyses without running the risk of selection bias. Second, as the data essentially captures perceptions, using only the information from a single source runs the risk that this source's preconceptions and (political) biases distort the analysis. For example, the index of property rights that by far has the broadest coverage is published by the Heritage Foundation, which has a very

distinct political (i.e. conservative) leaning.[2]

One way to resolve both problems is to combine different sources into an index of the (perception of) property rights protection, thereby reducing the risk for bias and increasing the coverage. The underlying assumption is that the measurement errors are uncorrelated over different sources, making a combined index more reliable than the individual sources (Kaufmann et al., 2009). The reason why we need a *new* index is that the indexes that are currently available are too broad for the purpose of this paper. While the Worldwide Governance Indicators contain various indicators on the protection of property rights, this is within a much broader category covering the rule-of-law; a category that also includes violent crime and human trafficking. Similarly, the Fraser Institute's index captures the 'strength of the legal system and property rights' from as early as the 1970s. To that end, it combines nine indicators that capture various aspects of the institutional framework, including judicial independence, reliability of the police, the cost of crime and military interference. Strictly speaking, only two indicators in this index directly measure property rights: i) protection of property rights from the World Bank's CPIA (cf. infra); ii) and the Heritage Foundation's index of property rights.[3] As these two sources are only available from 1994 earliest, this means that the earliest values of this index (from 1970-1993) cannot be used to measure property rights protection, as they capture other aspects of the rule-of-law.

2.1 Data sources on property rights

Given the unsuitability of the existing indicators, we first construct a new index of property rights protection, using all publicly available information on property rights. The selection of indicators of property rights is based on two criteria. Firstly, as there already exist a number of indicators that measure the overall quality of rule of law, we only use indicators that directly capture the protection of property rights. Focussing on property rights alone allows us to disentangle its effect from that of the overall quality of judicial system and other aspect of the institutional framework. Secondly, we use the original source data in its most disaggregated form.[4]

The following indicators pass these criteria (see table 4 in Appendix B for more detail):

- The Country policy and Institutional Assessment (CPIA) is a diagnostic tool used to analyse the institutional framework of countries around the world. Specifically, CPIA contains an indicator capturing the extent to which property rights and rule based governance offer protection, ranging from none at all (1) to strong protection (6). This assessments is performed by a number of multinational organisations, including the World Bank, the African Development Bank and the Asian Development Bank, which combined cover 86 countries from the mid 2000s to 2014.

- A second source of data on property rights is CEPII's Institutional Profiles Database (IPD) which is available from 2001 to 2012 (with gaps). In cooperation with the French government, CEPII sends out surveys on the perception of the institutional

[2] http://www.heritage.org/about-heritage/impact

[3] The remaining indicators are: iii) judicial independence; iv) impartial courts; v) military Interference in rule of law and politics; vi) integrity of legal system; vii) regulatory costs of the sale of real property; viii) reliability of police; ix) business costs of crime.

[4] When the different indicators are aggregated by source, this can give the false impression that this source gives a very clear signal as it hides the underlying variability in the indicators of property rights protection.

framework to the regional offices of the French development agency and the Economic Services of the Ministry for the Economy and Finance. These survey questions are then amalgamated into 130 indicators covering various aspects of the institutional framework, six of which deal directly with property rights: i) what is the effectiveness of legal measures to defend property rights between private agents; ii) does the government exert arbitrary pressure on private property; iii and iv) is there compensation in the event of de jure or de facto expropriation of (land) property; v and vi) is intellectual property protected in terms of counterfeiting or manufacturing secrets, patents, etc.; and vii) does the state formally recognise the diversity of land tenure system?

- The Economist Intelligence Unit's (EIU) market indicators and forecasts dataset is a commercially available dataset containing expert assessments on various economic and political characteristics of 60 countries. They include an assessment of the protection of property rights and intellectual property rights, ranging from very low (1) to very high (5).

- Global Insight (GI) also provides expert assessments on Business Risk and Conditions in 189 countries. Included in their 2015 dataset is an indicator of the risk of expropriation that ranges from no risk (0) to violent risk (10).

- The Institute for Management Development's (IMD) executive opinion survey is part of their World Competitiveness Yearbook. Among many other aspects, this survey measures the perception of business leaders regarding the enforcement of intellectual property rights as well as the protection of personal security and private property rights. Both indicators are scaled from 0 (no protection) to 10 (strong protection) and are available for 61 countries from 1995 to 2015.

- Similarly, the World Economic Forum's (WEF) Global Competitiveness Report tracks business leaders' opinion on the protection of both property rights and intellectual property rights. The survey is available for more than twice the number of countries (150) and started in the late 1970s. However, we only have access to the 2006 to 2015 data.

- Finally, the Heritage Foundation has been publishing an Index of Economic Freedom which covers almost 180 countries from 1994 to 2013. Part of this index is the assessment of the protection of property rights from an outlawing (0) to a guarantee (100) of rights.

2.2 A composite indicator of property rights

Combining these sources gives us a dataset of 18 indicators of property rights that cover 191 countries from 1994 to 2015. However, this dataset contains many gaps. For example, no country is covered by all indicators and one in four is covered by less than a quarter of the indicators. Overall, data availability is only 20%, but reaches almost 50% in 2009 and 2012, two of the years in which the IPD is available. These gaps in the dataset and differences in availability of the various indicators has to be properly accounted for when combining these indicators into one index of property rights. If the index is instead computed with whatever data is available, the actual shifts in property rights protection would be indistinguishable from changes in the availability of the indicators.

To that end, we use the approach proposed by Standaert (2015) and combine the indicators using a state-space model, i.e. the dynamic version of the unobserved components model used to construct e.g. the Worldwide Governance Indicators. Each of the indicators of property rights is considered an imperfect signal of the underlying notion of property rights protection (Kaufmann et al., 2009). At the same time, as it is determined by rules, laws and the institutional framework, the level of property rights protection is expected to have a strong time-persistence. The state-space model exploits this temporal dimension in order to combine data with strongly different availability characteristics and estimate the level of protection with greater precision. The level of property rights protection is first predicted based on both past and future values, and this prediction is subsequently updated with the information from which ever indicators are available in that year. However, the extent to which the level of property rights protection depends on its previous values is at no point imposed on the data. Rather, it is estimated within the model based on the characteristics of the underlying data. More information on the state-space model used and how it is estimated can be found in appendix A.

At the start of the dataset in 1994, the Property Rights Protection index (PRP) covers 100 countries and this number steadily increases until it reaches over 190 countries in the late 2000s. It values range from -11 to 20, with higher values correspond to a better protection. The 2014 values are shown in figure 1, with darker colours indicating a higher level of protection (i.e. higher PRP values).

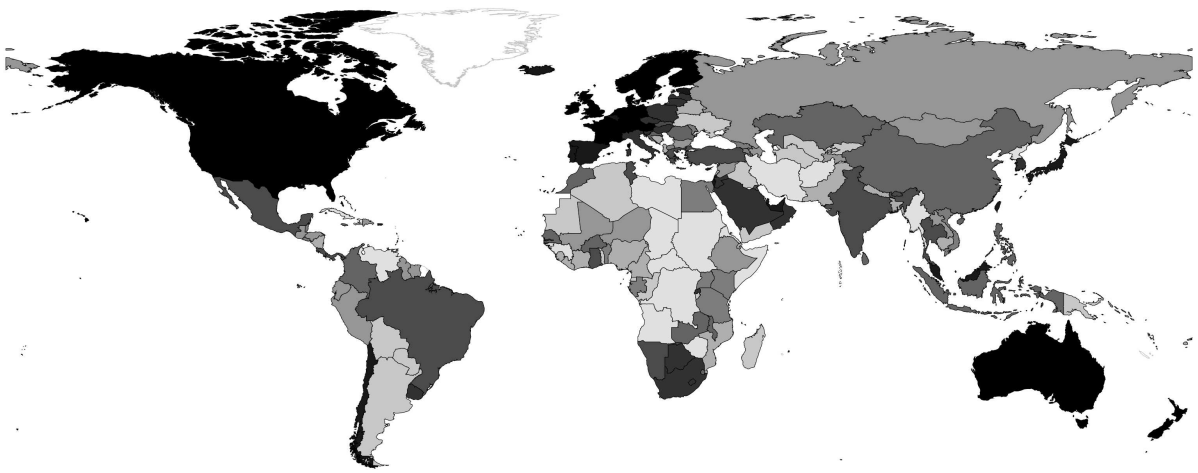

Figure 1: Level of property right protection in 2014 (dark = strong protection)

As the overall pattern in this figure suggests and in line with the findings from the literature, property rights turn out to be highly correlated with the level of development. However, this strong correlation is entirely driven by a very strong cross-sectional relation between both variables. In any given year, the correlation between property rights and the log of GDP per capita can be as high as 0.8. In contrast, when only the changes over time are taken into account, the correlation is negative (-0.21).[5]

Comparing the PRP index with the indicators that are most often used, we find a high correlation with both the Fraser Institute's and the Heritage Foundation's indexes (in excess of 0.9). In contrast, the correlation between the latter two is only 0.66, suggesting that the PRP index lies somewhere in between the two. In general, the correlation between

[5]While the overall correlation is slightly lower, this pattern is also present in the Heritage Foundation and Fraser indexes.

PRP and its constituent indicators is also high, falling for the vast majority of indicators between 0.7 and 0.93 (see table 5 in appendix B).

While the PRP index is also available for more countries (191 versus 180 or 80), the period covered by the the three indexes is relatively similar. However, because it has fewer gaps, PRP still increases overall data availability with 15% (Heritage Foundation) to 45% (Fraser Institute). Moreover, the increases in availability with respect to the other indicators of property rights is considerable –anywhere from a doubling to a 16 fold increase (table 5).

An important advantage is that PRP also provides an estimate of its reliability. Each observation come with a confidence interval that reflects the number of available indicators and their quality: the more higher-quality data is available, the smaller the confidence bands. Moreover, the estimation procedure returns hundreds of draws from the distribution of the PRP variable, allowing us to take the reliability of the PRP index into account in any subsequent regressions or computations as suggested by Desbordes and Koop (2015).

3 Econometric Specification and Data

3.1 Econometric specification

Using the newly constructed dataset we revisit the property rights-inequality nexus. To that end, we estimate a dynamic panel model that accounts for both country and time fixed effects. The baseline model is as follows:

$$y_{it} = \rho y_{it-1} + \gamma PRP_{it-1} + \upsilon_i + \psi_t + \nu_{it} \tag{1}$$

Where y_{it} is the outcome of interest, i.e. the level of inequality in country i at time t; PRP is our measure of property rights; and υ_i and ψ_t denote a full set of country fixed effects and time fixed effects, respectively.

Starting from this baseline, subsequent regressions add potential covariates of inequality to the model. In addition to democracy and property rights we also included their interaction term, allowing us to test whether in democracies property rights reduce inequality. Indeed, the existing literature is divided on whether democracies weaken or strengthen property rights. Limongi and Przeworski (1993); Acemoglu and Robinson (2005) and Boix and Stokes (2003), among others, concluded that democracies tend to weaken property rights, whilst others authors such as North (2000) suggest that property rights protection is more likely to occur in democracies than in dictatorship. It is therefore important to extend our analysis to investigate whether the effect of property rights on inequality is contingent on the type of democratic regime.[6] The fully augmented model is described as follows:

$$y_{it} = \rho y_{it-1} + \gamma PRP_{it-1} + x_{it-1}^{'}\beta + \upsilon_i + \psi_t + \nu_{it} \tag{2}$$

where $x_{it-1}^{'}$ is the set of potential covariates, including democracy and the interaction term between the latter and property rights. Both specifications include the lagged value of our dependent variable to capture persistence and mean reversion. In addition, we use the lagged values of all explanatory variables as we do not expect their impact on inequality to be contemporaneous.

[6] Amendola et al. (2013) also similar exercise albeit the authors did not justify this choice.

In order to estimate these models, we employ various estimation strategies. Our main approach is a generalised method of moments (GMM) estimator in line with Holtz-Eakin et al. (1988) and Arellano and Bond (1991). More specifically, we adopt the system GMM approach of Arellano and Bover (1995) and Blundell and Bond (1998). The system GMM extends the standard GMM by using moment restrictions of a simultaneous system of first-differenced equations and equations in levels. However, this comes at a cost as the number of instruments increases exponentially with the number of time periods, all of which leads to a finite sample bias. To circumvent this problem with adopt two approaches. First, we follow the standard route whereby we use the Windmeijer (2005) small sample correction and the collapsed instruments matrix option proposed by Roodman (2009). Second, we replicate all our results using the X-differencing dynamic panel method proposed by Han et al. (2014). The X-differencing approach proposes a bias-free parametric estimation to deal with the issue of weak instruments.[7]

Our empirical approach also deals with the issue of model uncertainty in relation to the choice of econometric specification. In adding our control variables to the baseline model, we first follow the standard practice-which consists of including the variables (for each of the specifications) in an arbitrary manner. However, one criticism of this approach is that the results obtained can be driven by the choice of 'arbitrary' model specification (see Madigan and Raftery, 1994; Draper, 1995; Raftery, 1995; Fernandez et al., 2001).[8] To evade this criticism we also derive our econometric specification using Bayesian model averaging technique.

Finally, as was noted in the previous section, all of the regressions above are adjusted so that they take the underlying uncertainty of the property rights measure into account. To that end, we follow Desbordes and Koop (2015) who use multiple imputation to correct for the uncertainty in the Worldwide Governance indicators. Instead of running the estimations using the most likely value of the property rights variable, the estimations are run hundreds of times using different draws from the distribution of PRP index. These resulting parameter estimates are subsequently recombined such that the point estimates and standard deviation completely take the uncertainty of the index into account. As the cross-country inequality measures also publishes a dataset containing different draws, we were also able to control for its uncertainty.

3.2 Data and descriptive statistics

For the empirical analysis, we construct a five year period panel of 147 countries from 1995-2012.[9] We also experiment using annual data for the same period. Our new measure of property rights is as described above.

Our outcome variable is inequality, which we measure using Gini coefficients. Until recent, it was hard to find data on inequality that could be meaningfully over countries. Most studies used their own definitions of income and applied it to different reference units: person, household, household adult equivalent, etc. There are a number of initiatives that have tried to address this issue: including the UNU-WIDER World Income Inequality Database (WIID), the Luxembourg Income Study (LIS) and the Standardized World

[7]Other authors, see for example Hsiao et al. (2002) and Kruiniger (2008) propose a quasi-maximum likelihood approach to deal with this issue.

[8]Montgomery and Nyhan (2010) provides a good review of the Bayesian model averaging developments.

[9]Our actual property rights index cover 191 countries but due to data limitations in terms of inequality and other covariates we limit our analysis to 147 countries.

Income Inequality Database (SWIID), produced by Solt (2016). While there is some debate on the use of particular inequality measures, in this paper we use the SWIID dataset for several reasons. First, among the various databases it has the largest coverage of countries (173) as opposed to e.g. LIS which is only available for 30 countries. Second, the SWIID also has fewer missing values which is important in our context given the use of the dynamic panel methods (based on 5 year and annual data). Third, unlike the WIID which only tracks the differences in definitions, SWIID maximizes the comparability of the data. Using the highly comparable LIS data as a yardstick, it statistically creates comparable income series from the WIID dataset. Finally, the SWIID is the only index of inequality that allows us to take its uncertainty into account using multiple imputation.[10]

Specifically, the Gini coefficients used in this study measure the inequality in equivalized household incomes (using square root scale).[11] Gini_net measures the inequality in the household's disposable income (post-tax and post-transfer), while Gini_market only considers at the market income (pre-tax and pre-transfers). Both use the LIS data as standard. More information on the precise definitions and construction of the Ginis can be found in Solt (2016). It should be noted that while the theoretical values of the Gini coefficients are bounded between 0 and 100, the actual values of both indexes lie between 15 and 75 meaning that they do not come close to these bounds.

Our covariates include: a measure of democracy (*p_democ*) from the Polity IV project;[12] secondary school enrolment ratio from the UN as a proxy for human capital; income per capita from the Penn World Tables; inflation, trade, employment in agriculture, foreign direct investment, M2 money supply, mineral rents and population density from the World Development Indicators; government expenditure from the IMF; the Bayesian Corruption Index (Standaert, 2015) and the Globalization index (Dreher, 2006). Descriptive statistics for all variables used in our sample are presented in Appendix B.

4 Results

4.1 Baseline results

Table 1 shows the results of our baseline model, i.e. based on the 5-year-averages panel and the system GMM (GMM-SYS). Column (1) shows results using only property rights (equation 1). The estimated coefficient of property rights is positive but only significant at the 10 percent level, meaning that property rights increase inequality. In Columns (2) we include democracy. The reported results show that the estimated coefficient of property rights remains positive and significant, while democracy significantly reduces inequality.

In Column (3) we augment our previous specification with an interaction term between property rights and democracy and the level of development captured by income per capita; whilst in Column (4) we add additional covariates (human capital, inflation and trade). In both columns the coefficient on democracy loses its significance and even switches signs, while the impact of property rights remains positive and statistically significant. Moreover, the estimated coefficient of the interaction term between property

[10] We did explore alternative measures but none have the standardised coverage of the SWIID.

[11] The total income of each household is divided by the square root of the number of people in the household.

[12] While Polity IV index of democracy does not allow us to take its uncertainty into account, it is far less sensitive to many of the other criticism cited against the existing indicators of property rights protection.

rights and democracy is negative and statistically significant. Overall, the marginal effect of property rights changes from positive to negative at high levels of democracy: at 8.26 in third and 9 in fourth column, both of which lie very close to the maximum value of the democracy index of ten. That democracy loses its significance in the last two columns could be due to multicollinearity problems with the interaction term. However, as the correlation between both variables is only 0.66, it seems more likely that the effect of democracy on inequality runs through its interaction with property rights.

The coefficients on the lagged value of our dependent variable, inequality, are positive, significant and relatively large. They even exceed unity in the first two specifications, but the exact coefficients change depending on the specification and estimation method. For example, when using X-differencing the coefficients are all slightly bigger than one, while in the yearly GMM estimates they are slightly smaller. These results confirm our earlier suspicions that inequality shows a high level of persistence and strongly argue for the need to include this variable.

Regarding the other control variables, we find that a rise in the income per capita increases inequality. Although the effect is not significant in this specification, this changes in some of the robustness checks. Regardless of their significance, it is important to note that the estimated coefficients of PRP and democracy on inequality are independent of the level of development.[13] These regressions also show that improvements in human capital significantly decrease inequality, while inflation significantly increases it. While trade also has a positive effect on inequality, it is insignificant in this specification.

4.2 Robustness checks

4.2.1 Annual data

To ascertain the validity of our results we conduct various robustness test. First, we replicate the above results using the annual data, the results of which are shown in Table 8 in Appendix C. As expected, the estimated impact of properly rights is smaller. Nevertheless, the statistical significance is even stronger and this remains robust over the various specifications. In line with the previous findings, the impact of democracy on inequality is no longer significant when the interaction term is added. The estimated coefficient of the interaction term also loses its significance when all control variables are added. However, this last specification can only be run with less than a third of the observations, meaning that this loss of significance can also be due to selection bias effects. The only control variables that are affected by the yearly estimations are income per capita and trade. The former is remains positive and is now significant in one specification, while the latter becomes significantly negative although with a very small coefficient.

4.2.2 X-differencing

As a second robustness check we use an alternative estimator, namely, the X-differencing dynamic panel method proposed by Han et al. (2014) on the annual data. The results are summarized in Table 2. We observe a similar pattern as with the previous results. Indeed, the estimated coefficient of property rights is positive and highly significant. While the coefficient on democracy remains negative when the interaction term is added, it still loses

[13] Although not reported here, we also include the square of income in our specifications to capture the 'inverted-U' hypothesis. However, we found no evidence of 'inverted-U' relationship and the coefficient of income per capita remained insignificant.

Table 1: Baseline results: System GMM with 5-year averages

	Dependent variable: Gini_net$_{t+1}$			
VARIABLES	(1)	(2)	(3)	(4)
Gini_net	1.036***	1.163***	0.834***	0.556***
	(0.148)	(0.204)	(0.076)	(0.173)
PRP	**0.291***	**0.508***	**0.786****	**1.132***
	(0.159)	(0.286)	(0.394)	(0.585)
p_democ		**-0.422****	**0.094**	**0.423**
		-0.228	-0.162	-0.369
PRP x p_democ			**-0.087***	**-0.137****
			(0.045)	(0.065)
Control variables				
Income per capita			0.69	1.639
			(0.384)	(1.617)
Human capital				-0.083*
				(0.044)
Inflation				0.067**
				(0.028)
Trade				0.007
				(0.021)
Constant	-3.108	-6.631	-2.41	2.397
	(6.194)	(8.172)	(5.392)	(10.960)
Observations	*388*	*361*	*349*	*299*
Number of countries	*149*	*136*	*131*	*118*
AR(1) Test (p-value)	*0.334*	*0.67*	*0.483*	*0.745*
Hansen Test (p-value)	*0.365*	*0.511*	*0.148*	*0.143*

Notes: (1) Robust standard errors in parenthesis. (2) *, ** and *** represent, respectively, statistical significance at 10, 5 and 1 percent levels. (3) Time specific dummies included.

its significance. The interaction term itself remains negative and statistically significant. While the effects on the main variables remain consistent, the same cannot be said of the control variables, where both the signs and significance tend to switch.

4.2.3 Bayesian model averaging

We also investigates whether our results are contingent on our choice of model specification. The model specification of the tests so far were based on suggestions from the theoretical literature, but one potential issue with this approach is that the results can be contingent on the precise model specifications. To circumvent this criticism we derive our econometric specification using a Bayesian model averaging technique.

A survey of the literature on the determinants of inequality suggests that there are around 15 potential determinants including property rights (see Appendix B for list of all variables). That would mean we potentially have 2^{15} (i.e. $32,768$) potential models specifications to choose from. The Bayesian model averaging technique allows us to choose our econometric specification based on the posterior inclusion probability (PIP). Variables with a $PIP > 0.5$ are included in our 'parsimonious' model as this suggests that they are

Table 2: Robustness check: X-differencing and annual data

	Dependent variable: Gini_net$_{t+1}$			
VARIABLES	(1)	(2)	(3)	(4)
Gini_net	1.051***	1.057***	1.088***	1.044***
	(0.009)	(0.009)	(0.012)	(0.171)
PRP	**0.088*****	**0.090*****	**0.148*****	**0.205*****
	(0.009)	(0.009)	(0.024)	(0.052)
p_democ		**-0.049***	**-0.002**	**-0.002**
		(0.025)	(0.026)	(0.026)
PRP x p_democ			**-0.008*****	**-0.007***
			(0.003)	(0.043)
Control variables				
Income per capita			0.310***	-0.186
			(0.066)	(0.231)
Human capital				0.01
				(0.006)
Inflation				-0.007
				(0.006)
Trade				0.006**
				(0.031)
Constant	-0.117***	1.184***	−0184***	0.026
	(0.039)	(0.186)	(0.054)	(0.068)
Observations	*1699*	*1362*	*1061*	*635*
Adj R-Squared	*0.946*	*0.945*	*0.969*	*0.969*

Notes: (1) Robust standard errors in parenthesis. (2) *, ** and *** represent, respectively, statistical significance at 10, 5 and 1 percent levels. (3) Time specific dummies included.

a 'good' predictor of our dependent variable, inequality. Following this exercise four other variables –in addition to property rights, democracy and income per capita– are included in our model specification: index of globalisation, employment in agriculture, population density and government expenditure.

Table 9 in Appendix C portrays the results using 5-year average and annual data as well as GMM-SYS and X-differencing. It is clear from the table that as far as property rights and the interaction term are concerned, the reported results of the GMM estimations mirror those reported previously. Indeed, the estimated coefficient of property rights is positive and highly significant whilst the estimated coefficient of the interaction is negative and significant, overall. However, in contrast with our earlier findings, the coefficient on democracy can remain positive and significant in some specifications. When using the X-differencing approach, only the positive coefficient on property rights survives.

Interestingly, not all control variables are significant. Government expenditures significantly decreases inequality in all specifications, and population density behaves similarly in all but the X-differencing approach. In contrast, agricultural employment is never significant and globalisation's parameter is inconsistent: positive and significant in the GMM estimations but negative and significant when using X-differencing.

4.2.4 Developing countries sub-sample

The final robustness check is to see whether our results remain valid when the sample is limited to developing countries (see Table 10 in Appendix C). Columns 1-5 report results based on the GMM-system estimation, whilst Columns 6-8 are obtained using the X-differencing method. The reported results are consistent with our previous findings using the whole sample. The only control variable that deviates from previous findings is the income per capita, which significantly decreases inequality in one specification.

4.3 Market income inequality

Having established the effect of property rights on net incomes, the next step is to see how it affects market income, before taxes and transfers. Based on the theory outlined above, we expect the coefficient on democracy as well as its interaction with property rights to lose significance as they are posited to run through the government's redistribution. Second, if the protection of property rights provide more economic opportunities for the middle class as proposed by Levi (1988), we would expect its positive effect on inequality to increase further. A similar effect would be seen, if following Acemoglu (2008) property rights provide only opportunities to the incumbent elite, i.e. those with most property. In contrast, if the effect of property rights is to increase the ability of the government to tax as proposed by (Besley and Persson, 2013), the coefficient on PRP might lose its significance altogether.

Table 3 shows the regression results when using market income inequality in the baseline model (using 5 year averages and system GMM). While the overall pattern of property rights and democracy remains the same, none of coefficients in any of the specifications remain significant. This is consistent with the theory of Besley and Persson (2013) that the effect of property rights works through the government's redistribution. Using the same robustness checks as for Gini_net does not significantly change this finding: the sign on the coefficients sometimes changes, but they remain insignificant. As they provide little extra information, these tables have been omitted for the sake of brevity.

5 Conclusion

Overall, the social science literature has failed to find a conclusive empirical evidence on the effect of institutions on inequality. In this paper we revisited the issue; more specifically we investigate the linkage between property rights and inequality. To achieve this, we first construct a new property rights index that is focused specifically on property rights instead of the more general rule of law. Using dynamic panel techniques –including the GMM-system and the X-differencing approach– we empirically test the impact of property rights on inequality for a selected group of countries. Our results reveal that increases in property rights are positively and statistically associated with inequality. We also test whether democratisation is associated with a reduction in inequality. In line with some existing studies, our results show that democracy does not exert any independent and direct effect on inequality. However, after interacting democracy with our property rights measure we found that the estimated coefficient of the interaction term was negative and significant –thus suggesting that democracy converts the positive significant effect of property rights into a negative significant effect. Loosely speaking, this implies that distributional effects of democratisation are channelled via property rights. It should be

Table 3: Market income inequality

	Dependent variable: Gini_market$_{t+1}$			
VARIABLES	(1)	(2)	(3)	(4)
Gini_market	1.245***	0.946***	1.014***	0.957***
	(0.324)	(0.299)	(0.212)	(0.308)
PRP	**0.077**	**0.043**	**0.348**	**0.407**
	(0.901)	(0.124)	(0.458)	(0.712)
p_democ		**0.325**	**0.241**	**0.105**
		(0.244)	(0.350)	(0.706)
PRP x p_democ			**-0.338**	**-0.046**
			(0.061)	(0.059)
Control variables				
Income per capita			-0.11	0.012
			(0.475)	(0.385)
Human capital				0.002
				(0.100)
Inflation				0.021
				(0.039)
Trade				-0.012
				(0.033)
Constant	-12.221	0.271	-1.204	1.483
	(15.143)	(9.693)	(11.541)	(10.676)
Observations	*285*	*269*	*259*	*230*
Number of countries	*120*	*136*	*106*	*99*
AR(1) Test (p-value)	*0.34*	*0.479*	*0.411*	*0.55*
Hansen Test (p-value)	*0.34*	*0.662*	*0.718*	*0.684*

Notes: (1) Robust standard errors in parenthesis. (2) *, ** and *** represent, respectively, statistical significance at 10, 5 and 1 percent levels. (3) Time specific dummies included.

noted that as income per capita was included as a control variable, the effect of property rights on inequality holds for any level of development. However, this does not mean that the absolute position of people decreased, if the improvement in property rights protection causes the overall income to increase sufficiently.

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A Estimating the level of Property Rights Protection

We employ a state-space approach in order to combine the many different indicators of property rights protection into one overall estimate. The underlying ideas behind this approach are twofold. Firstly, each of the indicators, $y^{\kappa}_{i,t}$, captures to some extent an unknown level of property rights protection $PR_{i,t}$. The precise way in which each indicator is related to PR can differ for each indicator. In this case we assume a linear relation between both with scaling parameters that can differ for all indicators (c^{κ} and $^{\kappa}$), but remain constant over countries. In addition to differences in the scaling of variables, they each also have a different reliability, as expressed by the variance of the measurement error, ϵ^{κ}. These ideas are summarized into a set of measurement equations, one for each of the 18 indicators:

$$\begin{aligned} y^{\kappa}_{i,t} &= c^{\kappa} + z^{\kappa} * PR_{i,t} + \epsilon^{\kappa}_{i,t} && (3) \\ \epsilon^{\kappa}_{i,t} &\sim N(0, H^{\kappa}) && (4) \end{aligned}$$

So far, the model is identical to an unobserved components model, like the one used to estimate the worldwide governance indicators. Where the two models diverge is in the second idea, which is that the level of property rights protection is likely to have a strong temporal correlation and this can be used to improve the estimations. This is captured in the state equation, which in our case is an AR1 model:

$$\begin{aligned} PR_{i,t} &= t_i * PR_{i,t-1} + \mu_{i,t} && (5) \\ \mu_{i,t} &\sim N(0, Q) && (6) \end{aligned}$$

The parameter t_i captures the extent to which the level of property rights protection depend on its previous values, and can be different for all countries. Like the parameters of the measurement equation, its values are determined within the model. The term $\mu_{i,t}$

captures any changes in property rights indicated by the y^{κ} that are not part of the time-dependence pattern. For example, if t_i is estimated to be one, any change in property rights protection will be captured by μ. In order to ensure that the model is identified, the variance of $\mu_{i,t}$ is normalized to one.

In order to estimate this model, we make use of Gibbs sampling which is a Bayesian estimation technique. The model ran a 100,000 iterations, of which 80,000 were discarded as burn-in. As we used uninformative (or flat) priors, our results are equivalent to those of a maximum likelihood estimator. The advantage of the Gibbs sampling approach is that produces random draws from the distribution of $PR_{i,t}$ that can subsequently be used to correct for the uncertainty of this variable. For more information, see Kim et al. (1999, chapters 7 and 8).

B Property rights: data sources and description

Table 4: Sources and definitions of property rights indicators

African Development Bank - CPIA	
ADB	Property Rights and Rule-based Governance
Asian Development Bank - CPIA	
ASD	Property Rights and Rule-based Governance
Economist Intelligence Unit - Market Indicators and Forecasts	
EIU1	Intellectual Property Rights Protection
EIU2	Property Rights protection
World Economic Forum- Global Competitiveness Survey	
GCS1	Intellectual Property Rights Protection
GCS2	Property Rights
Heritage Foundation - Index of Economic Freedom	
HTF	Protection of Property Rights
CEPII Institutional profiles database	
IPD1	Effectiveness of legal measures to defend property rights between private agents
IPD2	[d]oes the government exert arbitrary pressure on private property?
IPD3	Compensation in the event of [..] expropriation of land property?
IPD4	Compensation in the event of [..] expropriation of property for production?
IPD5	Intellectual property protection in terms of manufacturing secrets, patents, etc.
IPD6	Intellectual property protection in terms of counterfeiting
IPD7	Does the State recognize formally the diversity of land tenure system?
World Bank - CPIA	
WBD	Property Rights and Rule-based Governance
Institute for Management Development - World Competitiveness Center	
WCY1	Intellectual property rights are adequately enforced
WCY2	Personal security and private property rights are adequately protected
Fraser Institute -Protection of Property rights	
FRA[(a)]	Property Rights and Rule-based Governance

[(a)] Not included in the PRP index.

Table 5: Summary statistics of the indicators of property rights

Variable	Observations	Years	Countries	Correlation		
				Overall	Within	Between
PRP	3687	1994-2014	190			
ADB	433	2004-2014	40	0.882	0.898	0.910
ASD	250	2006-2014	31	0.735	0.594	0.716
EIU1	1257	1995-2015	60	0.917	0.952	0.952
EIU2	1257	1995-2015	60	0.906	0.927	0.927
GCS1	1369	2006-2015	151	0.932	0.925	0.923
GCS2	1369	2006-2015	151	0.925	0.920	0.919
HTF	3161	1994-2013	180	0.936	0.964	0.960
IPD1	396	2001-2012	141	0.754	0.848	0.837
IPD2	380	2001-2012	143	0.426	0.649	0.623
IPD3	390	2001-2012	143	0.708	0.773	0.760
IPD4	366	2001-2012	143	0.747	0.793	0.780
IPD5	392	2001-2012	141	0.740	0.770	0.765
IPD6	383	2001-2012	139	0.694	0.706	0.706
IPD7	228	2009-2012	139	0.374	0.478	0.467
WBD	761	2005-2014	81	0.917	0.869	0.885
WCY1	1114	1995-2015	61	0.929	0.966	0.965
WCY2	1114	1995-2015	61	0.847	0.884	0.883
FRA[(a)]	1986	1970-2015	141	0.920	0.218	0.875

[(a)] Not included in the PRP index.

Table 6: Gini and explanatory variables: sources and definitions

Variable	Source	Description
Gini_net	SWIID 2016	Gini coefficient on net income
Gini_market	SWIID 2016	Gini coefficient on market income
PRP	Authors	Property rights (higher values = better protection)
p_democ	Polity IV	Institutionalized democracy from 0 to 10 (most)
Human capital	UNESCO	Gross enrollment ration, secondary, both sexes (%)
Globalisation	Dreher (2016)	Globalisation from 0 to 100 (high)
Gov. expenditure	IMF	Government expenditure (% of GDP)
Corruption	Standaert (2016)	Bayesian Corruption Index
Income per capita	Penn World Tables	Log of GDP per capita (constant 2005 USD)
Emp. Agriculture	WDI 2016	Employment in agriculture (% of total employment)
Pop density	WDI 2016	Population density
Inflation	WDI 2016	consumer prices (annual %)
Trade	WDI 2016	Trade (% of GDP)
Mineral rents	WDI 2016	Mineral rents (% of GDP)
M2	WDI 2016	Money and quasi money as % of GDP
FDI	WDI 2016	Foreign Direct Investment (BOP, current USD)

Table 7: Gini and explanatory variables: summary statistics

Variable	Obs	Mean	St.dev.	St.dev Imputations[(a)]	Min	Max
Gini_net	4610	43.77	8.37	2.38	17.34	72.85
Gini_market	4612	36.80	9.84	1.64	15.68	69.35
PRP	3749	5.04	6.83	1.33	-10.83	20.40
p_democ	7251	4.28	4.21		0.00	10.00
Human capital	5127	62.06	33.95		0.19	165.58
Globalisation	6782	45.86	17.97		11.30	92.37
Gov. expenditure	3718	32.44	13.67		0.00	204.17
Corruption	5383	46.50	13.24	3.24	14.52	71.18
Income per capita	4209	8.70	1.25		5.48	11.85
Emp. Agriculture	2673	18.80	18.34		0.10	92.20
Pop density	8454	228.71	1235.46		0.63	1.88e4
Inflation	6323	25.36	373.49		-18.11	2.38e4
Trade	7314	75.85	48.72		0.02	531.74
Mineral rents	6740	1.04	3.42		0.00	44.64
M2	6714	47.76	172.10		.0167	7414.26
FDI	1581	-5.23e8	2.23e10		-2.32e11	2.25e11

[(a)] Average standard deviation of the imputed values.

C Robustness checks

Table 8: Robustness check: System GMM with annual data

	Dependent variable: Gini_net$_{t+1}$			
VARIABLES	(1)	(2)	(3)	(4)
Gini_net	0.994***	0.971***	0.991***	0.977***
	(0.045)	(0.005)	(0.004)	(0.002)
PRP	**0.103****	**0.077*****	**0.078*****	**0.019****
	(0.159)	(0.007)	(0.016)	(0.009)
p_democ		**-0.095*****	**0.007**	**0.01**
		(0.007)	(0.006)	(0.007)
PRP x p_democ			**-0.008*****	**-0.001**
			(0.002)	(0.001)
Control variables				
Income per capita			0.090***	0.022
			(0.024)	(0.017)
Human capital				-0.004***
				(0.000)
Inflation				0.003***
				(0.000)
Trade				-0.001***
				(0.000)
Constant	-0.7	1.184***	-0.724**	0.732***
	(1.895)	(0.186)	(0.324)	(0.192)
Observations	*1699*	*1362*	*1061*	*299*
AR(1) Test (p-value)	*0*	*0*	*0*	*0.002*
AR(2) Test (p-value)	*0.995*	*0.996*	*0.998*	*0.999*
Hansen Test (p-value)	*0.496*	*0.925*	*0.1*	*0.999*

Notes: (1) Robust standard errors in parenthesis. (2) *, ** and *** represent, respectively, statistical significance at 10, 5 and 1 percent levels. (3) Time specific dummies included.

Table 9: Robustness check: Bayesian model averaging

	Dependent variable: Gini_net$_{t+1}$		
	(1)	(2)	(3)
	GMM-SYS	GMM-SYS	X-differencing
VARIABLES	(5 year)	(annual)	(annual)
Gini_net	0.792***	1.006***	0.980***
	(0.129)	(0.004)	(0.032)
PRP	**1.704****	**0.821*****	**0.179*****
	(0.617)	(0.173)	(0.046)
p_democ	**0.517***	**0.192*****	**-0.099**
	(0.273)	(0.053)	(0.061)
PRP x p_democ	**-0.121***	**-0.077*****	**-0.003**
	(0.064)	(0.018)	(0.005)
Control variables			
Income per capita	1.032	1.499***	-1.040
	(1.172)	(0.254)	(0.327)
Globalisation	-0.161*	-0.061**	0.008***
	(0.092)	(0.023)	(0.014)
Emp. Agriculture	0.019	0.002	−0.001
	(0.121)	(0.021)	(0.014)
Pop. Density	-0.032**	-0.002***	-0.003
	(0.001)	(0.000)	(0.003)
Gov. Expenditure	-0.243**	-0.045*	-0.022**
	(0.105)	(0.026)	(0.001)
Constant	6.105	-14.789***	-0.109
	(21.324)	(4.665)	(0.067)
Observations	*282*	*1148*	*480*
AR(1) Test (p-value)	*0.861*	*0.007*	
AR(2) Test (p-value)		*0.4*	
Hansen Test (p-value)	*0.225*	*0.744*	
Adj R-Squared			*0.965*

Notes: (1) Robust standard errors in parenthesis. (2) *, ** and *** represent, respectively, statistical significance at 10, 5 and 1 percent levels. (3) Time specific dummies included.

Table 10: Robustness check: developing countries sub-sample

	Dependent variable: Gini_net$_{t+1}$							
			GMM				X-diff	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Gini_net	1.071***	0.883***	0.739***	0.713***	0.895***	0.993***	1.006***	1.074***
	(0.217)	(0.246)	(0.081)	(0.052)	(0.110)	(0.027)	(0.038)	(0.038)
prp	**0.531****	**0.534****	**0.922****	**1.332***	**0.706***	**0.062*****	**0.086*****	**0.457*****
	(0.233)	(0.235)	(0.362)	(0.196)	(0.382)	(0.011)	(0.016)	(0.117)
p_democ		**-0.106**	**0.149**	**0.225**	**0.498***		**0.084**	**-0.003**
		(0.363)	(0.178)	(0.136)	(0.211)		(0.052)	(0.079)
prp x p_democ			**-0.095*****	-0.015*	-0.035			**-0.040****
			(0.046)	(0.024)	(0.049)			(0.015)
Control variables								
Income per capita			0.502	0.258	1.279**			-0.965***
			(0.338)	(0.228)	(0.596)			(0.283)
Human capital				-0.042**				
				(0.018)				
Inflation				0.066***				
				(0.013)				
Trade				-0.036***				
				(0.011)				
Globalisation					-0.058			
					(0.074)			
Emp. Agriculture					**0.016**			
					(0.061)			
Pop. Density					**-0.002****			
					(0.001)			
Gov. Expenditure					**-0.254****			
					(0.110)			
Constant	-4.552	3.565	3.264	12.078***	-5.238	0.393*	-0.276	0.651
	(9.645)	(9.644)	(5.369)	(3.781)	(12.123)	(0.215)	(0.321)	(0.531)
Observations	*310*	*286*	*274*	*224*	*207*	*796*	*505*	*316*
AR(1) Test (p-value)	*0.644*	*0.895*	*0.239*	*0.792*	*0.165*			
Hansen Test (p-value)	*0.234*	*0.127*	*0.4*	*0.278*	*0.358*			
Adj R-Squared						*0.785*	*0.742*	*0.807*

Notes: (1) Robust standard errors in parenthesis. (2) *, ** and *** represent, respectively, statistical significance at 10, 5 and 1 percent levels. (3) Time specific dummies included.(4) Column 5 represents the specification derived from the Bayesian model averaging. (5) For the X-differencing we do not report results related to the full specification and the Bayesian model averaging due to the drop in the size of the observations, albeit the results are similar.