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Innovation, Inequality and Intellectual Property Rights

DIANA WEINHOLD

London School of Economics, UK

and

USHA NAIR-REICHERT*

Georgia Institute of Technology, UK

Summary. — We examine whether income inequality explains innovation across countries. The mechanism could be twofold: first, a large middle class could have an impact on institutions, including intellectual property rights (IPRs), which could in turn affect innovation. Second, evidence from US economic history suggests direct linkages between middle class share and innovation *via* supply and demand effects. Using IVE to address endogeneity, we find that middle class share explains patterns of resident patenting, while non-resident patenting is driven more by exogenous factors and global integration. Our results illustrate an additional channel through which income inequality can impact long run growth.

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1. INTRODUCTION AND BRIEF LITERATURE REVIEW

Most modern econometric analyzes have failed to find any robust relationship between income inequality and economic growth over the short or medium run (see, e.g., Banerjee & Duflo, 2000; Lundberg & Squire, 2003). However, there is an emerging literature on the determinants of cross country living standards that suggests that the presence of a strong middle class could be an important determinant of *long run* growth, through its impact on the evolution of institutional quality. Theoretical models linking income inequality to growth through its effect on the quality of institutions include Alesina and Rodrik (1994), Bénabou (2000), and Persson and Tabellini (1994).

Historical research in the United States (see Khan & Sokoloff, 2001; Sokoloff & Khan, 1990) has also suggested that inequality could have played a direct role in the evolution of innovation. Combining these two literatures, this paper asks whether income inequality could help explain current differential levels of innovation across countries. In particular, we are interested in the relationship between inequality, innovation and intellectual property rights (IPRs).

A fair number of previous studies of the relationship between income inequality and innovation have dealt with the effects of technological change on wage inequality within an economy (see, e.g., Acemoglu, 2002; Aghion, 2002; Huw, 1999; Mendez, 2002). Relatively fewer studies examine the reverse relationship of the effect of inequality on innovation, although there is a literature that looks at the market structure (i.e., concentration) of industry and its relation to innovation.¹ For example, Agell (2001) and Agell and Lommerud (1997) focus on developed countries' industrial relations and consider the linkages between wage inequality and the incentives to invest in physical and human capital. Bénabou (2005) theoretically explores how the diffusion of technology affects the abilities of individual nations to maintain their own redistributive institutions and social structures. However, all these studies are focused on different questions than we are here; in the former cases the emphases are on different forms

of industrial organization, while in the latter the theoretical chain of causality under consideration runs from innovation to inequality.

In this paper, on the other hand, we motivate our research by considering the theory and evidence regarding the *long run*, cross country relationships between inequality, institutional quality, and innovation. Recent historical and empirical literature on the relationship between initial natural endowments, European settlement patterns, and the subsequent evolution of both income inequality and quality of institutions has emphasized the close linkages between these factors, and their importance in explaining income differentials across countries.

Engerman, Haber, Sokoloff, and Menard (2000) and Engerman and Sokoloff (1997) hypothesize that variation in initial climactic and natural resource endowments leads to differences in the ability to establish European settlements as well as agricultural and extractive activities that differ in their ease of expropriation by political and economic elites. Areas that were naturally amenable to large-scale cash crops and/or extractive activities based on low-skilled slave or native labor also tended to have (for natural or political reasons) relatively low rates of European immigration.

Acemoglu, Johnson, and Robinson (2001) argues that these initial inequalities in wealth and human capital between the European elite and the working class were exacerbated by the evolution of institutions designed to protect the status of the upper class and facilitate the extraction of rents. In contrast, in areas where there was significant European settlement and agriculture was smaller scale and more focused on staple foods such as wheat, broader political participation resulted in institutions to support private property and check the power of the State.

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Acemoglu *et al.* (2001), Engerman and Sokoloff (1997), and Engerman *et al.* (2000) studies all suggest that inequality is intimately linked with the evolution of institutions, which in turn is an important determinant of income. Chong and Gradstein (2004) and Easterly (2007) make this link more explicitly. Easterly (2007) uses instrumental variables to show that a broad middle share does have a positive effect on development, and that the mechanism through which this effect takes place is through the effect inequality has on institutions. Chong and Gradstein (2004) use granger causality analysis to empirically demonstrate dual causality between income distribution and a variety of institutional quality measures.

While most of the cross country studies cited above focus on measures of property rights (risk of expropriation) as proxies for general institutional quality, this paper extends this literature to examine the relationship between income inequality and another potentially important dimension institutional quality: the protection of *intellectual* property rights (IPR). It is well established from both theory and empirical evidence that IPR can have an impact on rates of innovation at the level of the firm or industry, or (occasionally) across countries.²

If the fundamental linkages between income inequality and institutional design described in the Acemoglu *et al.* (2001) and Easterly (2007) (among others) analyzes are robust, then we might expect to see the impact of a large middle class on IPRs and/or innovation as well. Furthermore, there are several existing hypothesized mechanisms through which these possible effects might operate. In particular, the literature on early US industrialization suggests relative income equality in that country could have affected innovation *via* several channels.

From the demand side, Engerman and Sokoloff (1997), Khan and Sokoloff (2001), and Sokoloff and Khan (1990, 2000) argue that the presence of a large middle class helped spur innovation *via* their high demand for relatively inexpensive, mass produced manufactured goods. While low income people could not afford much non-essential consumption and high income individuals tended to demand customized products and services, the middle classes were oriented towards more standardized manufactures. In some sense this is a similar argument to the demand structure story of Zweimuller (2000), but is more nuanced with a focus on the incentives for innovation spawned by standardization. Sokoloff argues that much of the most fundamental advances in technology during the nineteenth century were concerned with the production of standardized manufacturing products.

On the supply side there are two channels through which a large middle class could matter for innovation. Khan and Sokoloff (2001) and Sokoloff and Khan (1990, 2000) note that in the United States, innovative activities were widely dispersed across a population with a high degree of market participation. They cite evidence from United States agriculture and manufacturing that suggest this broad based market activity in turn led to wide participation in the patenting of advances, which is based largely on incremental improvements on older technologies and organizations. They comment on the "wide range of industries to which American inventors had made technological contributions, the extraordinary creativity displayed in lowering the costs of producing standardized goods, and the broad spectrum of the population involved in inventive activity." (Sokoloff & Khan, 2000, p. 2)

Finally, a large and economically active middle class also helped spur innovation *via* its impact on the evolution of institutions. Khan (2002), Khan and Sokoloff (2001), Sokoloff (1988), and Sokoloff and Khan (1990, 2000) point out that mass economic and political participation led to early Ameri-

can IPRs that were significantly different from the prevailing European institutions. In the United States, patenting was much simpler, less expensive and available to a much broader spectrum of the population. Thus the combination of a broad middle class and stronger IPRs combined to provide the basis for unprecedented levels of innovation in early American industrialization and "this close relationship between access to markets and patenting is certainly consistent with the view that inventive activity was responsive to material incentives as well as to the availability and security of property rights in technology." (Sokoloff & Khan, 2000, p. 6)

Thus, theory suggests that income inequality could affect innovation (and thus growth) *via* its effect on demand for standardized manufactures, *via* the supply of savvy market participants, and *via* its effect on institutional quality (and especially of IPRs). While the existence of a broad middle class plays a central role in the Sokoloff story of historical United States innovation, to these authors' knowledge the possibility that inequality could play a role in the international evolution of IPR and innovation today has not been examined.³

While the basic hypothesis to be tested is that either inequality or high quality IPR (or both) may impact innovation, an important caveat to this story is that there might be several forms of endogeneity. For example, a highly innovative community (for whatever reason) might in turn demand stronger IPR protection, evolve in a more economically egalitarian fashion, and grow faster (and thus be able to afford higher quality institutions and income redistribution).⁴ In fact, the endogeneity of growth and institutions has been a major focus of the institutional and in the theoretical IPR literature, but despite the possibilities for reverse causality between IPR and innovation, we have not seen a wholly convincing empirical treatment of the problem in the cross country context.⁵ Thus we also consider the possibly endogenous nature of innovation, institutions, and income structure and attempt to sort out the distinct causal linkages between these variables by using an instrumental variables estimation strategy.

In sum, we are motivated by two main bodies of research that suggest that population-wide income inequality (as opposed to industry structure) could be an important determinant of innovative activity, and that both factors could be jointly determined along with growth and institutional quality. The contribution of this paper is thus twofold. Firstly we introduce income inequality as a determinant of domestic innovation in a cross country context; and second we explicitly address the possibility of endogeneity of IPRs, inequality, growth, and innovation in our empirical specification.

The paper proceeds as follows. In Section 2 we describe our data and outline the basic econometric method. Section 3 discusses the results and Section 4 concludes. A list of sample countries is presented in Table 5 in Appendix.

2. DATA AND METHODOLOGY

In this paper, we propose to examine whether inequality and IPRs can help to explain differential innovation rates across countries in the late 1990's. Although the theoretical framework which motivates our analysis is based on historical experience, due to data limitations the appropriate span of time to look for evidence of these effects is in the present. The theoretical linkages between income inequality and institutional quality play out over 100s, not 10s, of years. Indeed, within-country inequality evolves so slowly (see Quah, 2001) that we would not expect to observe any robust relationship between IPR and changes in income distribution year-on-year over

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