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Financial Market Access and Capital Income Inequality*

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Abstract

This paper explores the effect of broadening financial market access on inequality. I characterize in a parsimonious model of endogenous market participation how capital income inequality depends on financial market costs. A Kuznets curve type of relationship is uncovered under DARA utility. Data on the contribution of capital income to inequality (CKI) in eleven countries is presented against a measure of equity trading costs. Consistently with the model, during the last few decades of improving market access, the CKI has tended to increase where trading costs have been high, and to decrease where these costs have been low enough. The results imply that financial liberalization may have differential effects for inequality in advanced and in emerging economies.

1. Introduction

Interest in income distribution has grown following an increase in inequality in several industrialized countries over recent decades. The consensus explanation sees skill-biased technical change as one of its main sources. The spread of computers and advances in communication technologies are supposed to have increased the relative demand for skilled workers. As a result, labor income differentials across skill groups have increased.[1]

Labor income differentials are indeed likely to be the most relevant factor accounting for the recent increase in income inequality (see (Piketty, 2005)). However, changes in income from other sources can also be relevant. Jenkins (1995), for instance, analyzes the contribution of different sources of income to the UK's increase in inequality during the 1980s. He finds that more than half of the increase in income inequality can be attributed to self-employment income. Furthermore, the contribution of capital income to the change in inequality is similar to the contribution of labor earnings. Jenkins' analysis shows that sources of income other than from labor may be important for understanding changes in inequality. Indeed, relevant macroeconomic factors that have been shown to be closely related to inequality (such as inflation – see (Bulir, 2001); or the interest rate – see (Piketty, 1997), and (Brueckner et al., 2007) are likely to operate via the distribution of capital income.

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[1] The literature relating skill-biased technical change to wage inequality is enormous. See (Acemoglu, 2002) for a recent contribution and (Card and DiNardo, 2002) for a critical discussion. Johnson (1997) and Katz and Autor (1999) offer a survey where the skill-biased technical change hypothesis is put in the broader perspective of the recent increase in earnings inequality.

In this paper, I study the effect of financial market access on capital income inequality. This provides a novel channel through which technological progress affects inequality. In particular, new technologies have lowered the costs of access to financial markets, prompting participation. Those entering the financial market have experienced capital income gains, hence reshaping the distribution of capital income.[2] Indeed, household portfolios have experienced dramatic transformations in recent decades of accelerating technical change. In a book edited by Guiso, Haliassos, and Jappelli (2002), the editors note a significant move in household portfolios over recent decades towards more risky asset holdings, mostly driven by an increase in market participation. The increase has concerned both direct stock market participation and indirect participation through mutual funds and investment trusts.[3] One of the factors consistently emphasized in the literature accounting for this transformation is that the costs of participating in the financial market have decreased substantially – see (Poterba, 2001), and the Introduction chapter in (Guiso et al., 2002). Indeed, Rea et al. (2000) and Domowitz et al. (2001) provide evidence on the decrease in mutual fund fees and equity trading costs, respectively.

This paper studies how capital income inequality depends on financial market participation costs, using a parsimonious one-period model of endogenous market participation. In the model, individuals heterogeneous in their wealth holdings face the decision to participate in a financial market costly to access. Returns to the financial market are taken as fixed and considered to be risky. The model yields a Kuznets curve type of relationship between inequality and participation costs. In countries where participation costs are low, those who enter the financial market as access becomes easier are relatively poor, and their access drives capital income inequality downwards. The reverse occurs where participation costs are high. Thus, if financial access is broad enough, the negative effects of technological progress on inequality via labor income differentials may be tempered by its effects on participation costs.

The empirical implications of the model are considered: during the recent decades of technical improvement, where financial market participation has generally increased, the impact on inequality should depend on the level of participation costs. Data limitations imply that the empirical analysis carried out cannot be but crude. I discuss evidence on a measure of capital income inequality in eleven OECD countries and on equity trading costs. These data suggest that, during the last few decades, and consistently with the predictions of the model, in countries where trading costs are higher capital income inequality has increased and vice versa. A numerical example of the model shows that, under sensible conditions, the model can yield changes in inequality of considerable magnitude. This exercise thus lends credibility to the interpretation of the data suggested in this paper. Nevertheless, several caveats need to

[2] Returns to financial market participation can, indeed, be substantial, especially in the long run. Guo (2001) provides an example illustrating the significance of the difference between stock market and riskless returns over long periods of time. From 1871 to 1998, the continuously compounding stock market return was around 7 percent per year while the riskless return was 2.4 percent. With compounding, the implication of these differences in returns becomes substantial. One dollar invested in 1925 would have yielded 13 USD by 1996 if invested in the short-term government bond, but 1,370 USD if invested in large company stocks.

[3] See the Introduction chapter in (Guiso et al., 2002) for details.

be borne in mind. Notably, the proposed interpretation hinges on considering trading costs as a proxy for a fixed cost. The data presented expresses trading costs in proportional terms. However, in reality, fees paid in the financial services sector are non-linear in the amount invested. Typically, larger investors face lower rates. As a result, considering financial trading costs as fixed can be a good approximation.

The model proposed in this paper relates to the literature on financial market participation and inequality, including (Greenwood, Jovanovic, 1990), (Guvenen, 2006), and (Peress, 2003). These models analyze complex environments where financial market participation plays a role and study the implications for inequality. Contrary to these, the present paper focuses explicitly on the relationship between inequality and participation in a simple environment where mechanisms are transparent, and uncovers the non-linearities arising from this relationship.

The results of this paper can yield relevant insights for financial liberalization and inequality. They suggest that financial liberalization, when broadening access to the market, may have differential effects for emerging and advanced economies: liberalization would decrease inequality in advanced economies but increase it in emerging ones. Current empirical research on financial development and inequality yields mixed results: for instance, Beck et al. (2007) and Clarke et al. (2006) find that financial development reduces inequality, whereas Jaumotte et al. (2008) find the opposite. All use as measure for financial development essentially private credit over GDP, a measure that does not distinguish between financial deepening and financial broadening. The present paper argues for focusing on the possible non-linearities of the relationship *and* for disentangling financial deepening from broadening when measuring financial development (see also (Claesens, Perotti, 2007).[4]

The paper is organized as follows. Section 2 presents a parsimonious model of costly financial market participation and derives the implications of the model for inequality. Section 3 considers the empirical implications of the model, presenting data on inequality and proxies of participation costs. Section 4 brings together the results of the model with the data presented, dealing with quantitative issues and commenting on some caveats that need to be borne in mind when interpreting the data. Section 5 concludes.

2. A Model of Financial Market Participation

2.1 Economic Environment

Consider an economy populated by individuals, indexed by i, who are identical except in their level of wealth holdings w^i. The distribution of wealth is characterized by the cumulative distribution function $G(w)$ with support $[0, \infty)$. It is assumed that G is continuous and differentiable. At the beginning of the period, agents can invest their wealth in two assets, a risky asset and a safe asset. Investment in the safe asset is costless and yields a certain return $1+r$. Investment in the risky asset requires the payment of a fixed cost f that represents brokerage fees, information costs or the opportunity cost of time learning how the financial market works.

[4] Clarke et al. (2006) and Jaumotte et al. (2008) do consider (and reject) threshold effects in the relation between their measure of financial development and inequality, but do not distinguish between broadening and deepening.

The risky asset yields an uncertain *excess* return over the safe asset of $\tilde{x}$, with mean $\bar{x}$. It is assumed that $\bar{x} > 0$; i.e., that the expected returns of the risky asset are higher than the safe returns. Individuals who invest in the risky asset are said to participate in the financial market. At the end of the period, individuals collect the returns on their investments and consume them all.

Individuals derive utility from end of period consumption. The utility function u is assumed to be continuous and twice differentiable. Furthermore, it is assumed to be strictly increasing, strictly concave, and exhibiting decreasing absolute risk aversion (DARA). Thus, $u' > 0$, $u'' < 0$, and $\frac{d}{dc}\left(\frac{-u''}{u'}\right) < 0$. The assumption of DARA is regarded as sensible in the relevant literature: it formalizes the observation that richer individuals are more willing to take additive risks (see (Gollier, 2001)).

In order to illustrate explicitly the results of the model, a particular specification of the model is used. In this specification, excess returns of the risky asset are assumed to take only two values, x_H and x_L, with equal probability, where $x_L < 0 < \frac{1}{2}(x_H + x_L)$; i.e., the financial market yields higher returns than the riskless asset on average, but lower in the bad state. Furthermore, in this specification, the utility function u is assumed to be logarithmic; i.e., $u(c) = \log(c)$.

2.2 Financial Market Participation

Individuals in this economy decide to participate in the financial market if the expected utility they obtain by participating evaluated at its optimal portfolio choice is larger than the utility they obtain by not participating. The value obtained by an individual *i* not participating in the financial market V_N^i is, simply,

$$V_N^i = u\left(w^i\left(1+r\right)\right) \tag{2.1}$$

Individuals who participate in the financial market need to decide the share of their wealth to invest in the risky asset, denoted by π. Their value function V_P^i equals:

$$V_P^i = E\left[u\left(\left(w^i - f\right)\left(1 + r + \pi^* \tilde{x}\right)\right)\right] \tag{2.2}$$

where the optimal portfolio choice π^* solves the first-order condition,

$$E\left[u'\left(\left(w^i - f\right)\left(1 + r + \pi^* \tilde{x}\right)\right)\tilde{x}\right] = 0 \tag{2.3}$$

Individual *i* will participate in the financial market if the value of participating is larger than the value of not participating: if $V_P^i > V_N^i$. Whether this holds or not depends on *i*'s wealth level. In particular, the participation decision of different individuals is characterized by the wealth level of the indifferent individual, for whom $V_P^i = V_N^i$. The wealth threshold corresponding to the indifferent individual is denoted by $\tilde{w}$. Lemma 1 states the relationship between wealth, participation decisions, and fixed costs in this model.

Lemma 1: For given *f*, there is a unique $\tilde{w}$ such that $V_P^i = V_N^i$.

i) Participation decisions are characterized as follows:

$w^i > \tilde{w}$ Participates in the Financial Market.

$w^i < \tilde{w}$ Does not participate in the Financial Market.

ii) $\tilde{w}$ (f) is strictly increasing.

Proof: See *Appendix A*.[5]

With DARA utility, risk exposure increases with wealth. Therefore, only individuals wealthy enough invest in the risky asset a sufficient amount so that their returns compensate for the fixed costs. As a result, individuals with wealth higher than $\tilde{w}$ will participate in the financial market and those with wealth lower than $\tilde{w}$ will not. By the same argument, an increase in participation costs requires the indifferent individual to be wealthier and, hence, raises the wealth threshold $\tilde{w}$. An equivalent result has been shown to hold in more complex settings, using CRRA utility. For instance, Haliassos and Michaelides (2003), in a multi-period model with uninsurable labor income risk, find that richer individuals require higher fixed costs in order to be kept out of the market than poorer ones.

For the log utility case with two-state returns, the wealth threshold $\tilde{w}$ can be derived explicitly. Solving the first-order condition (3) for this case yields a portfolio choice of:

$$\pi^* = \frac{\frac{1}{2}\left(x_H + x_L\right)}{x_H\left(-x_L\right)}\left(1+r\right)$$

and equating V_P^i and V_N^i yields a wealth threshold for the indifferent individual of:

$$\tilde{w} = \frac{\upsilon}{\upsilon - 1} f \tag{2.4}$$

where $\upsilon \equiv \dfrac{\left(x_H - x_L\right)}{2\sqrt{x_H\left(-x_L\right)}}$, and measures the utility returns from the financial market.[6]

Expression (2.4) makes clear that the indifferent individual has wealth such that her utility returns from the financial market ($\left(\upsilon - 1\right)\tilde{w}$) compensate for the fixed costs. As fixed costs increase, the indifferent individual needs to be richer.

[5] The results in the lemma follow naturally from the effect of wealth on optimal portfolio choice. Thus, the proof is largely based on standard results displayed in Gollier (2001).

[6] To derive υ, just note that, with log utility, equation 2.2 becomes:
$V_P^i = E\left[\log\left(w^i - f\right)\right] + E\left[\log\left(1 + r + \pi^*\tilde{x}\right)\right]$. υ is defined so that $\log(\upsilon) = E\left[\log\left(1 + r + \pi^*\tilde{x}\right)\right] - \log\left(1+r\right)$.
Plugging π^* into that expression and using the simple two-state returns random variable for $\tilde{x}$ immediately brings the value of υ.

2.3 Capital Income

The expected capital income of each individual depends crucially on her initial wealth and participation status. Since the participation status of each individual is determined endogenously by her level of initial wealth, it follows that capital income is ultimately characterized in relation to initial wealth. For simplicity, I consider capital income net of fixed costs. The function relating expected capital income to initial wealth in the population $E\left[k\left(w^i\right)\right]$ is a piece-wise defined function where the components are the expected capital income of financial market participants $E\left[k_P\left(w^i\right)\right]$ and the capital income of the non-participants k_N. In particular, using lemma 1,

$$E\left[k\left(w^i\right)\right]=\begin{cases} E\left[k_P\left(w^i\right)\right]=\left(r+\pi^*\left(w^i\right)\overline{x}\right)w^i & \text{if } w^i>\tilde{w} \\ k_N\left(w^i\right)=rw^i & \text{if } w^i<\tilde{w} \end{cases} \tag{2.5}$$

The following lemma partially characterizes the relationship between expected capital income and wealth in this model.

Lemma 2: $E\left[k\left(w^i\right)\right]$ is increasing in w^i, with a discontinuity at $\tilde{w}$.

Proof: See *Appendix A*.

That capital income and wealth should be positively related in this model is straightforward. The discontinuity at the wealth threshold $\tilde{w}$ stems from two facts. First, capital income is considered net of fixed costs.[7] Second, and more substantially, risk aversion requires the indifferent individual to reap positive monetary gains in order to participate in the risky financial market.

In the case of log utility and two-state returns, the portfolio choice π^* does not depend on wealth. Hence, it is straightforward to see how capital income is increasing in wealth and the gains from participation are always positive:

$$E\left[k_P\left(w^i\right)\right]-k_N\left(w^i\right)=\pi^*\frac{x_H+x_L}{2}w^i=\frac{\left(\frac{1}{2}\left(x_H+x_L\right)\right)^2}{x_H\left(-x_L\right)}\left(1+r\right)w^i$$

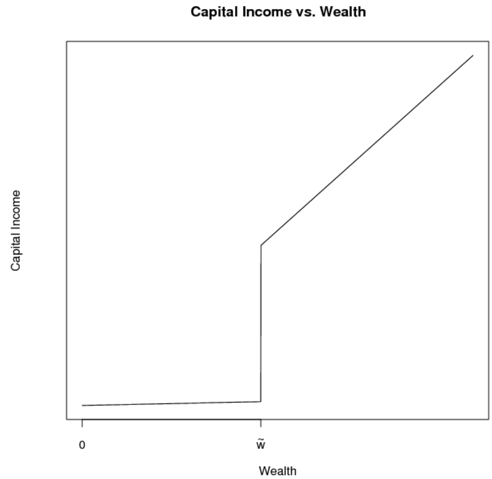
Figure 2.1 illustrates how capital income depends on wealth in this model, showing clearly the positive relation between the two variables as well as the discontinuity at $\tilde{w}$.

2.4 Capital Income Inequality

In this section, the basic result of the paper is presented in the form of a proposition. It is shown that *ex ante* capital income inequality, as measured by any of the standard inequality measures used, is first increasing and then decreasing in the level of participation costs. In what follows, for expositional clarity, I will obviate

[7] I consider capital income net of fixed costs for technical reasons, in order to simplify the analysis of inequality below. However, this choice is not likely to affect the main result of the paper.

FIGURE 2.1



the dependence of the different variables on w^i and drop the expectation operator for the expected capital income of participants.

Inequality can be measured in different ways. I consider the most commonly used inequality measures, such as the Gini coefficient, the family of Generalized Entropy (GE) measures, and their ordinal equivalents (i.e., measures that rank distributions in the same way as some member of the GE family), which include the variance and the square coefficient of variation. For these measures, the following proposition characterizes how inequality depends on fixed costs in this model.

Proposition 1: The level of *ex-ante* inequality I as measured by the Gini coefficient, any member of the family of Generalized Entropy, and any ordinally equivalent measures, satisfies the following property

There is an $\hat{f}(I)$ such that:

$$\frac{dI}{df} > 0 \text{ if } f < \hat{f}(I)$$

and

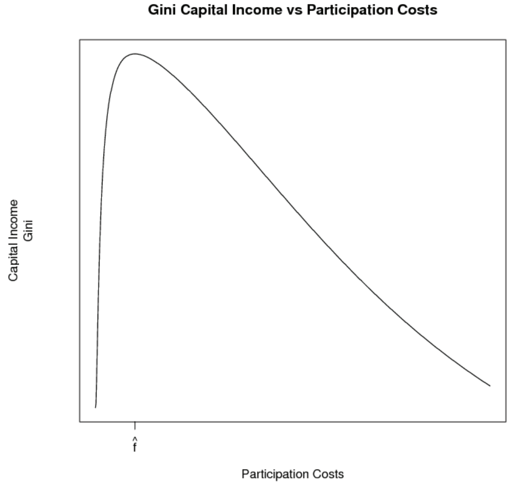
$$\frac{dI}{df} < 0 \text{ if } f > \hat{f}(I)$$

Proof: See *Appendix A*.

Proposition 1 states that capital income inequality, measured by any of the conventionally used inequality measures, is first increasing in participation costs, and then decreasing. The threshold of participation costs where the sign of the slope changes (where inequality is highest) depends on the inequality measure used. *Figure 2.2* illustrates this result for the Gini coefficient.

The mechanism underlying Proposition 1 can be grasped by taking the Gini coefficient as an illustration. Consider, in particular, the equation representing the mar-

FIGURE 2.2



ginal impact of participation costs on the Gini coefficient (Equation (18) in Appendix A, reproduced here for expositional purposes).

$$\frac{d}{df}Gini = 2g\left(\tilde{w}\right)\frac{d\tilde{w}}{df}\frac{-\left(\tilde{k}_P - \tilde{k}_N\right)}{\bar{k}}\left[G\left(\tilde{w}\right) - \frac{1+Gini}{2}\right] \tag{2.6}$$

Equation (2.6) is best understood as the product of two terms. The first term is the density of the population who leave the financial market $g\left(\tilde{w}\right)\frac{d\tilde{w}}{df}$ times the percent capital income they lose by leaving the market $\frac{-\left(\tilde{k}_P - \tilde{k}_N\right)}{\bar{k}}$.[8] The second term is the position these individuals hold in the distribution of capital income $G\left(\tilde{w}\right)$ relative to the overall level of inequality $\frac{1+Gini}{2}$. Notice that, in order for inequality to change with participation, it is necessary that the indifferent individual sees a discrete jump in her capital income upon changing participation status: if $\tilde{k}_P = \tilde{k}_N$, then $\frac{dGini}{df} = 0$. In this model, indeed, individuals who leave the market see their capital income decrease by a discrete amount. Hence, the first term is always negative. As a result, whether inequality is increasing or decreasing in participation costs (the sign of $\frac{dGini}{df} = 0$) depends exclusively on the second term: on whether the indifferent individual is high or low in the distribution of capital income relative to the overall

[8] $\tilde{k}_P$ and $\tilde{k}_N$ denote the capital income of the indifferent individual in case of participation and of non--participation, respectively. $\bar{k}$ denotes the average capital across the population.

level of inequality. This depends on the level of participation costs. Thus, when participation is sufficiently easy to access, the indifferent individual is low in the distribution of income relative to the level of inequality, and inequality will increase as this individual leaves the market. Eventually, as participation costs become sufficiently high, the indifferent individual will be high in the distribution relative to overall inequality, and inequality will decrease as she leaves the market.

More sophisticated models of financial market participation would also generate the result of Proposition 1. For example, a model with heterogeneity in ability and initial wealth where the financial market participation decision is taken after labor income is realized will work in a similar fashion. One would simply have to consider wealth holdings w^i as the sum of labor income and initial wealth. The remaining developments go through in the same manner. Indeed, the crucial ingredients for the result to hold are that the wealth of the indifferent individual is increasing in participation costs and that new participants experience a capital income gain. These ingredients are generally ensured when the financial market is risky and the utility of individuals exhibits concavity and DARA. More sophisticated models of financial market participation need not yield such a clean result as the one in Proposition 1. The mechanism driving the result, however, would generally still be present.

3. Cross-Country Evidence on Participation, Participation Costs, and Inequality

Cross-country data on financial market participation and on capital income inequality is scarce, mainly because a population survey is required in order to construct each data point. Empirical exercises using participation costs are even more problematic, for these costs include components impossible to measure accurately, such as the opportunity costs of time spent understanding how the financial market works. With these limitations in mind, this section proceeds to bring the model to bear on available data (see *Appendix B Table B0* for an overview of the data used).

The source of inequality data presented in this chapter is the study by Forster and Pellizzari (2000). Forster and Pellizzari (2000) analyze trends in income distribution in different countries from the mid-1980s to the mid-1990s.[9] The data they use regard eleven OECD countries. In their analysis, total personal income is decomposed by income sources. The sources used are labor income, capital and self-employment income, taxes, and transfers. Capital income includes interest, dividends, and realized capital gains.[10]

Forster and Pellizzari (2000) report the evolution of total income inequality in the eleven OECD countries, decomposing it into the contribution of different income sources. This decomposition is performed according to the procedure in Shorrocks (1982). Shorrocks (1982) deals with the problem of finding a rule that determines the contribution of factor k to inequality I of total income y. Shorrocks (1982) shows

[9] The data of the report, in turn, come from a questionnaire that the OECD sent to national experts. Efforts in sending a questionnaire as detailed as possible have been made. The level of comparability is, however, lower than would be the case if one used harmonized surveys, such as the data from the LIS project. The advantage is that data for more countries and time periods are available. See the Appendix in (Forster, Pellizzari, 2000) for details.

[10] Self-employment income is included in the category of labor income in Germany and Canada.

that there is only one decomposition rule that satisfies a set of convenient axioms, including, notably, that the contributions of all factors add up to the measure of inequality of total income. This rule states that the contribution to inequality of factor k, S^k, equals

$$S^k = \frac{\text{Cov}(k, y)}{\text{Var}(y)} I$$

The contribution of a factor thus defined depends positively on its share in total income. In order to control for changes in the share of the factor, Forster and Pellizzari (2000) perform a shift share analysis over S^k. This exercise permits them to isolate how much of the change in inequality is due to the change in the distribution of the factor itself, which they call its "net contribution". The data I present are precisely the changes in the "net contribution" of capital and self-employment income to inequality. Forster and Pellizzari (2000) measure inequality using the Gini coefficient; thus, the data I present is, in words, the change in the Gini coefficient due to changes in the distribution of capital and self-employment income. In what follows, it will be denoted for short the Contribution of Capital Income to Inequality, or CKI. Denoting the average capital and total incomes over the population by $\overline{k}$ and $\overline{y}$, respectively, the CKI is hence defined as $CKI = \frac{\overline{y}}{\overline{k}} S^k$.[11]

The first column in *Table B1* in *Appendix B* displays the change in CKI for different OECD countries. The pattern of change varies across countries. In the Netherlands, France, and the US, the net contribution of capital and self-employment income has decreased. In Italy, Germany, Denmark, Finland, Sweden, the UK, Canada, and Australia, it has increased. The magnitude of these figures is substantial. The absolute value is larger than 2.5 percentage points (pp) in eight out of the eleven countries considered, and higher than 4 pp in five of them. In order to put these magnitudes into perspective, notice that the increase in income inequality in the US from 1968 to 1992 is measured by an increase in the Gini coefficient of 3.5 pp, and the one for the UK (deemed as "unparalleled" in (Atkinson, 1997)) was of 10 pp.

The theoretical results in the previous sections relate changes in capital income inequality to the level of participation costs. The second column of *Table B1* in *Appendix B* displays information on trading costs for the countries stated above. The data come from (Domowitz et al., 2001) and correspond to average explicit

[11] In order to grasp what the CKI captures, consider the case where income comes only from two sources, capital and labor income (k and W). Then, the *CKI* can be written in the following way,

$$CKI = \frac{\text{Var}(k) + \text{Cov}(k, W)}{\overline{k}^2 + \overline{k}\overline{W}} \frac{I(y)}{SCV(y)} \tag{3.1}$$

where *SVC* is the square coefficient of variation. Equation (3.1) shows that the contribution of capital income to inequality depends positively on the variance of capital income and on the covariance between capital and labor income, appropriately normalized. Indeed, capital income contributes to inequality to the extent that is unequally distributed (as captured by the variance term) and to the extent that it covaries with other sources of income. In consequence, the *CKI* rises either if capital income becomes more unequally distributed or if it becomes more correlated with labor income.

equity trading costs, which include commissions and fees paid for each transaction, in basis points. The data refer to the years 1996 to 1998. Ideally, one would want to use data from the 1980s, the start of the period considered in the inequality data, but these data are not available. Nevertheless, two points justify the use of the proposed data. First, the main factors affecting participation costs in the last few decades have been all-pervasive (technical progress, privatization, social security crises, etc.) In that respect, the ranking of countries in terms of participation costs may not have changed substantially over the 1980s and 1990s. Second, the country studies in (Guiso et al., 2002) – for Germany, Italy, the Netherlands, the UK, and the US – suggest an ordering in terms of financial market access costs similar to the data provided for the available years of the 1980s and 1990s. Indeed, market *participation rates* (not costs) tended to be highest in the US and, among the continental European countries, the lowest in Italy and the highest in the Netherlands.[12]

Figure B1 in *Appendix B* plots the change in the net contribution of capital and self-employment income to inequality against explicit equity trading costs. *Figure B1* shows that there is a tendency for the net contribution of capital and self-employment income to inequality to have fallen in countries where trading costs are low and to have risen in countries where trading costs are high. In other words, this figure suggests a positive relationship between the *change* in CKI and the *level* of trading costs. A closer look at the figure reveals that the slope of this relationship is higher for Continental European countries.

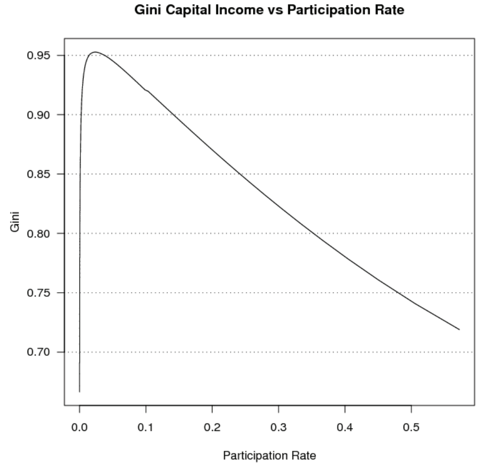
4. Linking Model and Data

In the previous sections, I have provided a partial characterization of how capital income inequality depends on participation costs. Capital income inequality displays a hump shape in participation costs. When the *level* of participation costs is high, a *decrease* in participation costs brings to the profitable financial market individuals who are already rich. Capital income inequality, as a result, increases. The opposite occurs when participation costs are low. This mechanism offers a plausible explanation of the data presented in the previous section, assuming a uniform decrease in participation costs in all countries. Consider that the US, France, and the Netherlands lie to the left of the critical level $\hat{f}$ of Proposition 1, and the rest of the countries to the right. Participation costs have fallen in all countries. The consequence has been a decrease in the CKI in the US, France, and the Netherlands, and an increase in the remaining countries.

In order to interpret the data in this way, some points need to be considered. The first point relates to quantitative issues: can the mechanism proposed yield changes in inequality large enough under sensible conditions? Second, even if this is the case, the theoretical framework matches only imperfectly the data presented. Thus, several caveats need to be borne in mind when interpreting the data in the light of the model proposed. These points are considered in this section.

[12] The exception is the UK, with high participation in the 1990s despite ranking high in the trading cost data. The reason for this discrepancy is most likely the unusually intense privatization of the Thatcher years. Indeed, direct stockholding in 1983 was lower in the UK than in Germany (Guiso et al., 2002).

FIGURE 4.1



4.1 Quantitative Issues

The model presented is extremely stylized and, hence, cannot be hoped to offer accurate quantitative results. Nevertheless, a numerical example using sensible values can convey how large the effects in the model can be. To do so, I use the specification with log utility and two-state returns and "calibrate" the model as carefully as possible (see *Appendix B*). For the exercise, I focus on participation rates instead of participation costs, as the former can be measured with more accuracy.[13]

Figure 4.1 shows the Gini coefficient for capital income as a function of the rate of market participation.[14] The range of values that the Gini coefficient takes is indeed substantial, rising from its lowest to its highest point by 30 pp. In the downward sloping portion of the curve, it can be seen that a change in participation of 10 pp is associated with a change in the Gini of approximately 5 pp, a slope of around 1/2. The slope of the upward sloping portion is even higher in absolute value.[15]

The relation between these magnitudes is not wide off the mark relative to the observed changes in the CKI and in participation. From the data above, among the economies that have seen the CKI decrease (the US, the Netherlands, and France), the average change has been of -1.7 pp. Among those where it has increased, the average change has been 3.3 pp. As to changes in participation, according to Guiso et al. (2002), from 1989 to 1995, the proportion of the population holding risky financial

[13] Another reason to focus on participation rates, instead of costs, from a quantitative perspective is that the use of participation costs suffers from the partial equilibrium version of the equity premium puzzle (see (Haliassos, Michaelides, 2003)).

[14] In the case where the only source of income is capital, as in the stylized model presented, the CKI obviously equals the Gini coefficient of capital income.

[15] In the figure, the peak of inequality occurs at very low levels of participation. This is because of the low risk aversion implicit in logarithmic utility. In (unreported) exercises with constant relative risk aversion utility, the peak moved rightwards as risk aversion increased. Incidentally, the magnitude of the changes also decreased, with a range of Gini of around 13 pp when using a coefficient of relative risk aversion of 10.

assets rose by 8.7 pp and 6.5 pp in the US and Italy, respectively. In Germany, from 1983 to 1995, it rose by 6.5 pp. Obviously, these changes in financial ownership structure are partly explained by mechanisms unrelated to the ones considered in this paper (such as the looming retirement of the baby boom generation). However, as mentioned above, there is wide agreement in the relevant literature that falling participation costs have been a key factor behind these trends.

In sum, plausible changes in participation can have a sizable impact on capital income inequality. Indeed, in the model proposed, changes in inequality are driven by the capital income gain of participation, arising from the risk premium. The impact can be large because so is the risk premium, particularly when compounded over a number of years. According to the Mehra and Prescott estimates, the risk premium compounded over ten years can be as high as 88 percent.

4.2 Caveats

The mechanism highlighted in this paper can account qualitatively for the evidence presented above and is, furthermore, sizable enough under sensible conditions. There are, however, several caveats regarding the suggested interpretation of this evidence. First, the data includes jointly income from capital and from self-employment, except for Germany and Canada. In most of the countries (except, for instance, Italy), the importance of self-employment income is fairly small, so that it is not likely that the movements in the contribution to inequality are driven by self-employment income. Moreover, the type of argument developed in this chapter could be adapted to self-employment income. Recent work, such as (Fonseca et al., 2001), emphasizes the importance of firm start-up costs as a deterrent to entrepreneurship, especially regarding small business and self-employment. In their model, changes in start-up costs affect the ability threshold required for an individual to become an entrepreneur instead of a worker. The mechanism is hence similar to the one in this paper, although there are obvious limitations in the analogy. For example, start-up costs are probably more related to bureaucracy than to the forces likely to have lowered participation costs in recent decades, such as computerization.

Second, the data presented on capital income does not include unrealized capital gains. Realized capital gains are included. The argument of this paper hinges on the assumption that risky financial markets, such as the stock market, yield a higher return than the risk-free bond. It is difficult to assess if, on average, realized capital gains suffice to yield this equity premium.

Third, the measure of inequality used in the data is the CKI while the results of the model were derived for capital income inequality. As was shown above (see Equation (3.1) in footnote 11), the contribution of a factor to inequality depends, not only on the inequality of the factor itself, but also on the correlation of the factor income with other sources of income. The model presented has no predictions regarding correlations between incomes from different sources, as it does not include any other source of income apart from capital income. Labor income could be included and allowed to be heterogeneous and the results would generally be strengthened if wealth and labor income are positively correlated. In that case, when participation costs are high, those who enter the financial market as access is made easier are rich not only in terms of capital income, but also in terms of labor income. Their increase in capital income raises not only capital income inequality, but also the covariance between labor and capital income. The reverse occurs when participation costs are low. There are several mechanisms that would yield such a positive relation between wealth and labor income. A positive correlation between wealth and labor income would arise if labor income heterogeneity arises from differences in ability and ability is positively correlated with wealth. Alternatively, this positive correlation would arise if labor income heterogeneity arises from differences in education and education decisions are taken in a setting of borrowing constraints (see (Pellicer-Gallardo, 2005)).

Finally, in order to relate the data to the theoretical results, the measure of trading costs in the data is taken as a proxy for a fixed cost even if explicit trading costs are expressed in basis points. This may not be so problematic, for trading costs are generally non-linear in the amount invested (high volumes usually face lower rates) and, hence, considering them as a fixed cost can be a good approximation.

5. Concluding Remarks

This paper has argued that technical change affects inequality not only through labor income differentials, but also through capital income. Computerization and the development of information technologies have decreased the costs of access to financial markets. This fall of access costs has prompted participation in profitable financial markets by different groups in the population. The groups of the population who enter the financial market depend on the level of participation costs. If participation costs are high, those who enter are rich, and their entrance drives inequality upwards. The opposite occurs where participation costs are low. Using a parsimonious model of costly financial market participation, it was shown that this result holds if the financial market is risky and utility displays DARA.

Data on the contribution of capital income to inequality in eleven OECD countries has been presented. Consistently with the theoretical mechanism proposed, countries where the contribution of capital income to inequality has gone down, such as the US, France, and the Netherlands, are those where trading costs are the lowest. In the rest of the countries, the contribution of capital income to inequality has increased. Moreover, the magnitude of these changes in inequality is substantial, and it was shown that the mechanism proposed can deliver changes of such magnitude under sensible conditions. Therefore, even if there are several caveats to bear in mind when doing so, the mechanism highlighted in the theoretical sections can rationalize the data presented.

The results of the paper suggest that technical change and financial liberalization, if they succeed at broadening access, may have differential effects on inequality in emerging and advanced economies. Only in advanced economies would they help reduce inequality. For this scenario to occur, however, barriers to entry to the financial market need to be already low. It is important to bear in mind that these barriers are not only monetary. Education, for example, also matters for financial market participation. Indeed, as argued in (Pellicer-Gallardo, 2005), it seems plausible to assume that participation costs are heterogeneous across education groups. Technical change and financial liberalization alone may not be enough to bring participation costs for the uneducated low enough to induce them to participate, hence requiring complementary educational policies.

APPENDIX A

Proofs

A1 Proof of Lemma 1

i) In order to prove lemma 1, the following argument is used. Define $\tilde{w}$ as the w such that $V_P(w) = V_N(w)$. It is shown that, for any $\tilde{w}$ it holds that $\frac{\partial}{\partial w} V_P(\tilde{w}) > \frac{\partial}{\partial w} V_N(\tilde{w})$; i.e., at any point where $V_P(w)$ and $V_N(w)$ cross, the slope of V_P is higher than that of V_N. Then, using an argument in the spirit of the index methodology (see (Mas-Colell et al., 1995, p. 615)) this implies, by continuity, that $V_P(w)$ and $V_N(w)$ cross only once, at $\tilde{w}$, and that, furthermore, for $w^i > \tilde{w}$, $V_P > V_N$, and vice versa.

Using this argument, it is necessary just to show that for any $\tilde{w}$ it holds that

$$\frac{\partial}{\partial w} V_P(\tilde{w}) > \frac{\partial}{\partial w} V_N(\tilde{w}) \tag{5.1}$$

Denoting $u(c_P^*; w)$ to the maximum utility of a participant with wealth w condition (5.1) can be written as

$$E\left[u'\left(c_P^*; \tilde{w}\right)\left(1 + r + \pi^* \tilde{x}\right)\right] > (1 + r) u'(c_N; \tilde{w})$$

which, using the first-order condition (3), simplifies to

$$E\left[u'\left(c_P^*; \tilde{w}\right)\right] > u'(c_N; \tilde{w}) \tag{5.2}$$

Now, at $\tilde{w}$ it holds, by definition,

$$E\left[u\left(c_P^*\right)\right] = u(c_N) \tag{5.3}$$

By Jensen's Inequality, conditions (5.2) and (5.3) hold simultaneously when $-u'(c)$ is a concave transformation of $u(c)$. This, in turn, is equivalent to $-u''(c)/u'(c)$ being decreasing (see (Gollier, 2001, Proposition 4)).[16] Thus, if the utility function exhibits Decreasing Absolute Risk Aversion, $\frac{\partial}{\partial w}(V_P - V_N)(\tilde{w}) > 0$.

[16] In particular, consider, as in (Gollier, 2001)), the function ϕ as the transformation from u into $-u'$. Thus, $-u'(c) = \phi(u(c))$. Totally differentiating this expression yields that $\phi'' < 0$ (i.e., $-u'(c)$ is a concave transformation of $u(c)$) is equivalent to $-u'''(c)/u''(c) \geq -u''(c)/u'(c)$ for all c. This latter condition is, in turn, equivalent to $-u''(c)/u'(c)$ being decreasing.

ii) By the Implicit Function Theorem, we have

$$\frac{d}{df}\tilde{w} = -\frac{-\frac{\partial}{\partial f}E\left[V_P\left(\tilde{w}\right)\right]}{\frac{\partial}{\partial w}E\left[V_P\left(\tilde{w}\right)\right]-\frac{\partial}{\partial w}V_N\left(\tilde{w}\right)} \tag{5.4}$$

which, using the first-order condition (2.3), simplifies to

$$\frac{d}{df}\tilde{w} = \frac{E\left[u'\left(c_P^*;\tilde{w}\right)\right]}{E\left[u'\left(c_P^*;\tilde{w}\right)\right]-u'\left(c_N;\tilde{w}\right)}$$

Hence, $\frac{d}{df}\tilde{w} > 0$ holds when conditions (5.2) and (5.3) above hold simultaneously. Thus, as shown before, it holds for any DARA utility function.

A2 Proof of Lemma 2

It is straightforward that $k_N\left(w^i\right)$ is increasing. I focus, hence, on $E\left[k_P\left(w^i\right)\right]$. Differentiating $E\left[k_P\left(w^i\right)\right]$ with respect to w^i yields

$$\frac{d}{dw^i}E\left[k_P\left(w^i\right)\right] = r + \pi^*\left(w^i\right)\overline{x} + w^i\frac{d\pi^*}{dw^i}\overline{x}$$

The first two terms in the sum are clearly positive. Given the assumed positive risk premium, the third term is positive as well if $\left(w^i\frac{d\pi^*}{dw^i}\right) > 0$. Gollier (2001) in Proposition 8 proves that this is the case if utility is DARA.

It remains to check that $E\left[k_P\left(w^i\right)\right] > k_N\left(w^i\right)$ at the discontinuity point $\tilde{w}$ This follows directly from equation (2.5). The difference between the two portions equals $E\left[k_P\left(\tilde{w}\right)\right]-k_N\left(\tilde{w}\right) = \tilde{w}\pi^*\left(\tilde{w}\right)\overline{x}$, which is positive, since so are the three terms in the product.

A3 Proof of Proposition 1

The proof uses the same line of argument as that of lemma 1. First, the local extreme values for the inequality indices as a function of *f* are characterized. The level of *f* at which the local extreme values are attained is denoted $\hat{f}$. Second, it is shown that, at $\hat{f}$, the inequality indices are concave in *f*. Using an argument in the line of the index methodology, it is then concluded that there can only be a unique local extreme value, which is a maximum and is attained at $\hat{f}$. The result in the proposition follows immediately.

Some additional notation will prove useful. Denote by $\bar{k}$ the average capital income in the population: $\bar{k} = \int_0^\infty k dG$. Each individual's capital income relative to the population average will be denoted by $\kappa : \kappa = \frac{k}{\bar{k}}$. We can have κ_P or κ_N if the individual participates in the financial market or not, respectively, and, for the indifferent individual (with wealth $\tilde{w}$), we will write $\tilde{\kappa}_P$ in case of participation and $\tilde{\kappa}_N$ in case of non-participation.

The Gini coefficient of capital income can be written as

$$Gini = \frac{2\int GkdG}{\int kdG} - 1 \tag{5.5}$$

and the GE family of measures is defined as[17]

$$GE^{(\theta)} = \int \frac{1}{\theta(\theta-1)} \left(\frac{k}{\int kdG} \right)^{\theta} dG - \frac{1}{\theta(\theta-1)}$$

Consider first the GE family. Denote by $h(\kappa)$ the integrand in the definition of the GE measures:

$$h(\kappa) \equiv \frac{1}{\theta(\theta-1)} \kappa^{\theta}$$

Thus, using lemma 1, the GE measures in this model become:

$$GE = \int_0^{\tilde{w}} h(\kappa_N) dG + \int_{\tilde{w}}^{\infty} h(\kappa_P) dG - \frac{1}{\theta(\theta-1)} \tag{5.6}$$

Differentiating (5.6) with respect to *f* using Leibniz's rule, and rearranging terms, yields

$$\frac{d}{df} GE = -g(\tilde{w}) \frac{d\tilde{w}}{df} (\tilde{\kappa}_P - \tilde{\kappa}_N) \left[\frac{h(\tilde{\kappa}_P) - h(\tilde{\kappa}_N)}{\tilde{\kappa}_P - \tilde{\kappa}_N} - \theta \left(GE + \frac{1}{\theta(\theta-1)} \right) \right] \tag{5.7}$$

The term outside the square brackets is strictly negative, by lemmas 1 and 2. Thus, $\frac{d}{df} GE = 0$ when

$$\frac{h(\tilde{\kappa}_P) - h(\tilde{\kappa}_N)}{\tilde{\kappa}_P - \tilde{\kappa}_N} = \theta \left(GE + \frac{1}{\theta(\theta-1)} \right) \tag{5.8}$$

[17] For the special cases where $\theta = 1$ and 0 the index becomes $GE^{(1)} = \int \frac{k}{\int kdG} \log\left(\frac{k}{\int kdG} \right) dG$ and $GE^{(0)} = -\int \log\left(\frac{k}{\int kdG} \right) dG$, which correspond to the Theil index and the Mean Logarithmic Deviation, respectively (see (Cowell, 2000)).

Denote by $\hat{f}$ the level of $\hat{f}$ such that (5.8) holds. In order to check the concavity of *GE* at $\hat{f}$ differentiate (5.7) with respect to *f*. Since, by construction, at $\hat{f}$ (5.8) holds and $\frac{d}{df}GE = 0$ the expression becomes simply

$$\frac{d^2}{df^2}GE = -g(\tilde{w})\frac{d\tilde{w}}{df}(\tilde{\kappa}_P - \tilde{\kappa}_N)\left[\frac{d}{df}\left(\frac{h(\tilde{\kappa}_P) - h(\tilde{\kappa}_N)}{\tilde{\kappa}_P - \tilde{\kappa}_N}\right)\right] \tag{5.9}$$

Since, as said before, the term outside the square brackets is strictly negative,

$$\frac{d^2}{df^2}GE < 0 \text{ if } \qquad \frac{d}{df}\left(\frac{h(\tilde{\kappa}_P) - h(\tilde{\kappa}_N)}{\tilde{\kappa}_P - \tilde{\kappa}_N}\right) > 0 \tag{5.10}$$

Now, notice that the expression inside the parenthesis is the slope of the segment connecting $h(\tilde{\kappa}_N)$ and $h(\tilde{\kappa}_P)$ in the $h(\kappa)$ schedule. It is then clear that (5.10) will hold if $h(\kappa)$ is convex for all κ and $d\tilde{\kappa}_P / df, d\tilde{\kappa}_N / df > 0$. First, by differentiating twice the definition of $h(\kappa)$ it can be easily checked that $h(\kappa)$ is indeed convex. Second, by the definition of $\tilde{\kappa}_{P,N}$, a sufficient condition for $d\tilde{\kappa}_{P,N} / df > 0$ is that $d\tilde{k}_{P,N} / df > 0$ and $d\bar{k} / df = g(\tilde{w})\frac{d\tilde{w}}{df}(\tilde{k}_P - \tilde{k}_N) < 0.$
The two conditions follow from lemmas 1 and 2.

For the Gini coefficient, the same argument applies. The expression for $\frac{d}{df}Gini$ is

$$\frac{d}{df}Gini = -2g(\tilde{w})\frac{d\tilde{w}}{df}\frac{\tilde{k}_P - \tilde{k}_N}{\bar{k}}\left[G(\tilde{w}) - \frac{1 + Gini}{2}\right] \tag{5.11}$$

At $\hat{f}$ (where $\hat{f}$ is defined, again, as the level of *f* where $\frac{d}{df}Gini = 0$), *GINI* is concave. Indeed, differentiating (5.11) with respect to *f* and evaluating the expression at $\hat{f}$ yields

$$\frac{d^2}{df^2}Gini = -2\left(g(\tilde{w})\frac{d\tilde{w}}{df}\right)^2\frac{\tilde{k}_P - \tilde{k}_N}{\bar{k}}$$

which is clearly negative.

APPENDIX B

Values Numerical Example

The numerical example presented corresponds to the specification of the log utility function and two-state market returns. The initial wealth distribution is assumed to be lognormal with parameters μ and σ^2. Market excess returns in the two states, x_H and x_L, are chosen so as to match the first two moments of Mehra and Prescott estimates, when compounded over ten years, following the procedure used in (Bertaut, Haliassos, 1997)).[18] This yields excess returns of $x_H = 1.89$ and $x_L = -0.13$ and a riskless rate of 0.8 The variables of the model *w* and *f* are interpreted as normalized by the median initial wealth e^{μ}. This normalization makes the Gini coefficient *of capital income* independent of μ so that the initial wealth distribution using the normalized variables is fully characterized by the parameter σ.[19] In order to give a value to this parameter, I use the fact that there is a simple one-to-one relationship between σ and the Gini coefficient from a lognormal distribution.[20] Thus, I give σ the value that generates the Gini coefficient for wealth "typically observed" in industrialized countries, on the basis of the evidence in (Davies, Shorrocks, 1999). Davies and Shorrocks (1999) show the Gini coefficient for wealth in eleven OECD countries in the 1980s. These range from 0.52 in Japan to 0.79 in the US, with a cross-country average of 0.65. Thus, the Gini for initial wealth is taken as 0.65 which yields $\sigma = 1.32$.

Data Sources

TABLE B0

	Countries	Years	Source
Inequality (CKI)	Australia, Canada, Denmark, Finland, France, Germany, Italy, Netherlands, Sweden, UK, US	Mid80s–mid90s	(Forster, Pellizzari, 2000)
Trading Costs	Australia, Canada, Denmark, Finland, France, Germany, Italy, Netherlands, Sweden, UK, US	1996–1998	(Domowitz et al., 2001)
Participation	Germany, Italy, Netherlands, UK, US	selected years from early 1980s to 1998	Guiso et al. (2002)

[18] The yearly mean return is 6.98 % with a standard deviation of 16.54 %. The estimate for the riskless rate is 0.8 %.

[19] This is achieved by using the property of the lognormal distribution according to which if x is lognormal with parameters μ and σ^2, then $e^{-\mu}x$ is lognormal with parameters 0 and σ^2, (see (Aitchison, Brown, 1957)).

[20] In particular, $Gini = 2N\left(\frac{\sigma}{\sqrt{2}}\right) - 1$, where $N(x)$ is the standard normal distribution evaluated at x (see (Aitchison, Brown, 1957)).

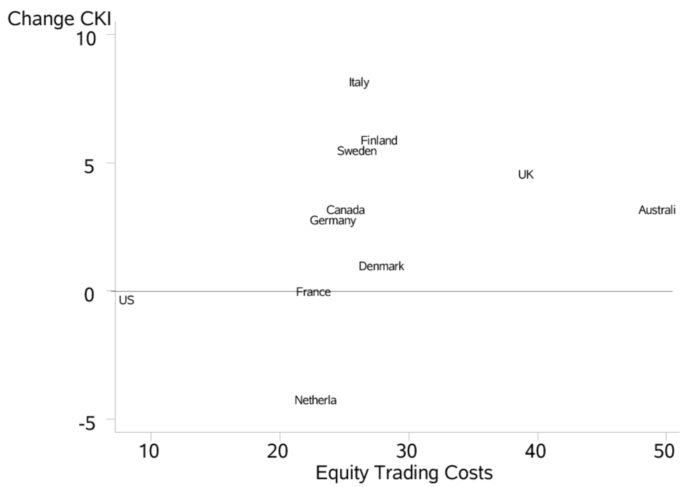
TABLE B1

	Change CKI [a]	Trading Costs [b]
Australia	3.0	49.5
Canada	3.0	25.3
Denmark	0.8	28.1
Finland	5.7	27.9
France	-0.2	22.8
Germany	2.6	24.3
Italy	8.0	26.3
Netherlands	-4.4	23.0
Sweden	5.3	26.2
UK	4.4	39.3
US	-0.5	8.3

Notes: [a] Change in Contribution of Capital an Self Employment Income to Inequality from mid 80s to mid 90s. Absolute change. See Section 3. *Source*: (OECD, 2000).

[b] Basis points. *Source*: Elkins/McSherry Co., Inc. Quoted in (Domowitz et al., 2001).

GRAPH B1



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