International financial integration, volatility, and inequality in a stochastically growing open economy

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Abstract

In this paper, we study the impact of the increase in cross border holdings of capital and income volatility on inequality for a small open economy with borrowing constraints. The results of the model depend crucially on labor elasticity and relative initial endowments of domestic capital and foreign bonds. When labor is highly inelastic, we show that higher international financial integration will increase inequality, because it makes investing in foreign bonds more attractive, which, given that richer individuals have higher relative endowments of wealth (foreign bonds), makes rich individuals even richer. Higher

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domestic volatility would also increase inequality, whereas higher external volatility would diminish inequality. When labor is highly elastic, the results are more ambiguous because the impact on portfolio shares is weakened by the adjustment of labor. Second, we find that the main results for the model are broadly supported by the empirical evidence using the most recent data for a sample of 106 countries for the period ranging from 1970 to 2015.

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*Keywords:* Cross border holdings of capital, net foreign asset position, borrowing constraints, volatility, inequality.
Inequality is usually seen as a great concern for society, especially since the Great Recession. Pope Francis (@Pontifex) tweeted that “Inequality is the root of social evil” on April 28, 2014. Inequality is regarded as one of the “greatest dangers in the world” in many countries, especially developed ones (Pew Research Center, 2014). Many people also believe that “The rich get richer and the poor get poorer” (Pew Research Center, 2013). Empirical evidence shows that inequality seems to have increased in many countries (especially, but not only, rich countries) during recent years. For example, the Gini coefficient increased in China from 0.291 in 1981, to 0.327 in 1990, and 0.474 in 2012. In the United States the Gini coefficient was 0.394 in 1970, 0.428 in 1990, and 0.48 in 2014.

At the same time, cross border holdings of gross financial assets and liabilities have increased enormously, especially since mid-1990s to 2007. For example, the stock of external assets and liabilities with respect to GDP in the world was around 45% in 1970, and 100% in 1987, but then accelerated by mid-1990s to around 200% in 1998 and 400% in 2007 (Lane and Milesi-Ferretti, 2007, 2017). This has also implied dramatic changes in net external financial positions in many countries. Recent research suggests that the growth in cross-border holdings of capital in terms of world GDP has come to a halt, but figures are very high yet (Lane and Milesi-Ferretti, 2017).

The impact of globalization on inequality has received much attention in the literature, especially concerning trade openness. This literature is vast and gained an enormous impetus up to the late 1990s, and it has also received much attention in the late 2000s. However, the recent tremendous change

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1This phenomenon, also known as the “Matthew effect” (coined by sociologist Robert K. Merton (1968)), goes back to ancient times, as captured by a passage in the Bible: “For unto every one that hath shall be given, and he shall have abundance: but from him that hath not shall be taken even that which he hath” (Matthew 25:29, King James Version).

2See Milanovic (2016), for instance.

3Data is from “All the Ginis” database, as described in Section 3.

4Most notably in Greece, Portugal, Spain, the United States, and the United Kingdom.

5Some key studies include Feenstra and Hanson (1996) and Borjas, Freeman, and Katz (1997), for instance. Epifani and Gancia (2008) find that trade globalization increases inequality, Goldberg and Pavcnik (2007) that trade globalization have increased inequality in developing countries, Helpman et al. (2017) that trade affects wage inequality through between-firms differences in wages, and Antràs, Alonso de Gortari, and Itskhoki (2017) that trade integration leads to an increase in inequality in the distribution of disposable income, despite taxation is progressive, which they employ to evaluate its impact on welfare. See also Winters, McCulloch, and McKay (2004) for a survey on the impact of trade liberalization on poverty.
in the magnitude of cross-border holdings of both assets and liabilities has sparsely been studied in terms of its consequences for inequality.

In the literature more closely related to this paper, recent empirical research by Jaumotte, Lall, and Papageorgiou (2013) find that trade globalization (as measured by some ratio of exports and imports to GDP) is associated with less income inequality, but financial globalization (as measured by the ratio of cross-border assets and liabilities to GDP), and foreign direct investment especially (as measured by the ratio of inward foreign direct investment stock to GDP), in contrast, seems to be related with higher inequality. However, they also find that technological progress seems to be a major force driving inequality. These results hold for 51 countries (20 developed and 31 developing) over 1981-2003, based on an extended version of the World Bank *Povcal* database. However, they used inequality data based on both income and consumption surveys, which are not directly comparable, given that consumption-based Gini coefficients tend to show lower inequality. Bergh and Nilsson (2010) showed that globalization, as measured by freedom to trade internationally (trade taxes, tariff rates and trade barriers, and capital market controls), increases inequality, for 79 countries for the period 1970-2005, based on the Standardized World Income Inequality Database (SWIID) compiled by Solt (2008). Bumann and Lensink (2016) have recently shown that financial liberalization (as measured by financial depth through capital account liberalization) reduces inequality, for five-year panel covering 106 countries over the time period 1973 to 2008 based on the database compiled by Galbraith and Kum (2005), where capital account liberalization is measured as Chinn and Ito (2008) and financial depth is captured by the ratio of private credit over GDP. Recent research by Furceri and Loungani (2016) has found that capital account liberalization [as measured by Chinn and Ito (2008)] increases the Gini measure of inequality, based on panel data estimates for 149 countries from 1970 to 2010 under the SWIID.

However, these papers, and this literature generally, lack a convenient

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7 Consumption-based Gini coefficients are also typically employed in developing countries where income distribution is difficult to measure (Jaumotte, Lall and Papageorgiou, 2013, p. 276).

8 See Claessens and Perotti (2007) for a survey on the impact of financial development on inequality (as measured by stock market capitalization, financial intermediation deepening, and so on) on inequality.
theoretical framework to explicitly analyze the impact of the enormous increase in cross-border holdings of capital and, in turn, the net foreign asset position, on inequality, because the main focus on this literature has been mostly empirical. In a key theoretical contribution to this literature, García-Peñalosa and Turnovsky (2006) analyzed the impact of risk and volatility on income distribution when labor is elastic. This implies that labor reacts to different degrees of risk, which induces changes in factor prices and thus it affects the distribution of income. They find that an increase in production risk raises the mean growth rate, its volatility, and the degree of income inequality. A greater variance of output has a strong income effect (given that agents are risk averse), which induces them to increase their labor supply, increase their savings, and thus raise the growth rate. The increase in the labor supply raises the return to capital and lowers the real wage, thereby affecting the distribution of income. Since labor is more equally distributed than is capital, income distribution becomes more unequal.\(^9\) However, their analysis was focused on a closed economy, which is restrictive for modern economies.\(^10\)

Income volatility is also an important driver for inequality.\(^11\) Research by Breen and García-Peñalosa (2005) showed that countries with more output volatility (usually associated to emerging and developing countries) seem to display higher Gini coefficients, and vice versa, based on the database of 80 countries (22 developed countries) for the period 1960-1990, developed by Deininger and Squire (1996). This evidence seems to be confirmed by recent research (Calderón and Yeyati, 2009 and Huang et al., 2015).\(^12\) However, the impact of income volatility on inequality has not been analyzed combined

\(^9\)In addition, the design of tax policy is analyzed. They find that increasing (average) welfare and the growth rate does not necessarily imply an increase in inequality, and that fiscal policy has conflicting effects on the distributions of gross and net income.\(^10\)Chen and Turnovsky (2010) analyze the relationship between growth and inequality in an open economy, where the impact of structural changes on growth and distribution depend crucially on whether the underlying heterogeneity derives from the initial endowment of domestic capital or foreign bonds.\(^11\)Haussmann and Gavin (1996) suggested this relationship originally. See the introduction in Huang et al. (2015) for a recent reference on the mechanisms through which volatility impacts on inequality.\(^12\)Volatility seems to have declined since the mid-1980s to mid-2000s for most of the major industrial economies as well as for the emerging and developing economies, but there is not a clear systematic empirical relationship between financial globalization and output volatility in the literature yet (Doyle and Faust, 2005; Kose et al., 2006).
to the huge increase in cross border holdings of capital, as it has been the case since the 1990s especially.

In this paper, we offer two main contributions. First, we build a full-fledged model that studies the impact of the increase in cross border holdings of capital and income volatility on inequality, thus extending to a small open economy the work of García-Peñalosa and Turnovsky (2006). A key feature of our model is that the domestic economy has access to international financial markets with borrowing constraints, so that the higher the indebtedness of the country the higher the interest rate it will face in international markets. The results of the model depend crucially on the elasticity of labor and the initial relative endowments of domestic capital and foreign bonds. Thus, when labor is highly inelastic and relative endowments of domestic capital and foreign bonds are equal, we show that a higher degree of financial globalization will increase inequality, because higher financial globalization makes investing in foreign bonds more attractive, which, given that richer individuals have higher relative endowments of wealth (foreign bonds), makes richer individuals even richer. Higher domestic volatility would also increase inequality, because higher domestic volatility makes investing in foreign bonds more attractive, which, given that richer individuals have higher relative endowments of wealth (foreign bonds), makes rich individuals even richer. A higher external volatility, on the contrary, diminish inequality. When labor is highly elastic the results are more ambiguous because the impact on portfolio shares is weakened by a stronger adjustment of labor. Second, we find that the main results for the model are broadly supported by the empirical evidence using the most recent data for a sample of 106 countries for the period ranging from 1970 to 2015. It is not clear that higher financial integration is associated to higher inequality, but we show that a higher level of financial liabilities (assets) is strongly associated to higher (lower) inequality. Furthermore, more indebted countries are associated to higher degrees of inequality. Finally, we find that more volatility seems to be associated to higher inequality. However, the pattern seems to have changed since the Great Recession.

An important issue concerns with how inequality is measured. First, there are different ways to measure inequality. The most widely employed magnitude to measure inequality is income inequality, which is often described by the Gini coefficient as a measure of how equally or unequally income is distributed along the population. Second, there are different Gini coefficients depending on the different methodologies employed to calculate it. Thus, the
Gini coefficient can be typically expressed on net or gross terms, it can be based on income or consumption data, or it can be provided from individuals or households. Third, the Gini coefficient vary substantially depending on the sources of data employed to calculate it. Choosing the right database involves relevant trade-offs, concerning the accuracy and comparability of the data, and the size of the sample. On the one hand, we find Gini coefficients based on actual household surveys or estimates based on regressions or other methods. The former is typically preferred to the latter, because it is usually more accurate being based on actual data. However, this also usually implies a lower sample size. The best source for actual data on inequality is probably “All the Ginis” (ATG hereinafter) database, compiled by Branko Milanovic (since 2004) to “standardize” Gini coefficients, due to its coverage and comparability from different sources among countries. \(^{13}\) The best source for other type of estimates is probably the SWIID, produced by Frederick Solt (2008).\(^{14}\) We are inclined to employ the ATG database for being based on actual data. In addition, it allows to capture conveniently differences in sources through dummies. We also make convenient adjustments to address heterogeneity across countries and years. And the results found confirm that this approach seems to be fruitful. Recent research provides excellent reviews on these databases [see Ferreira, Lustig, and Teles (2015), for instance].

This paper proceeds as follows. A stylized model for a small open economy is described in Section 1. Section 2 analyzes the determinants of the distribution of income. Section 3 shows the empirical evidence. Section 4 concludes.

1 A stylized model for a small open economy

In a small open economy the representative agent \(i\) chooses his rate of consumption and allocates his portfolio of wealth among two assets: domestic capital, \(K_i\), which is not traded, and foreign bonds, \(B_i^*\), which are traded. The representative agent is endowed with a unit of time that can be allocated

\(^{13}\)Nine different databases form part of ATG database, where the Luxembourg Income Study (LIS) is considered the best source. See Ravallion (2015) for an excellent review of LIS. Solt (2008) considers the LIS is the “gold standard of cross-nationally comparable inequality data”. However, the LIS mainly covers only data for developed countries.

\(^{14}\)See Jenkins (2015), and Badgaiyan, Pirttilä, and Tarp (2015) for recent reviews.
either to leisure, $l_i$, or to work, $1 - l_i$, where $0 < l_i < 1$. Output is produced by representative agent $i$ according with the production function:

$$dY_i = A [(1 - l_i) K_i]^{\alpha} K_i^{1-\alpha} (dt + du), \quad (1)$$

where $dY_i$ denotes production by firm $i$, $A$ the level of technology, $K_i$ the stock of capital in the economy, $K_i$ stock of capital by firm $i$, $\alpha$ the weight of labor, and $1 - \alpha$ the weight of capital. The term $du$ represents a proportional domestic productivity shock: $du$ is the increment of a stochastic process $u$. Those increments are temporally independent and are normally distributed. They satisfy that $E(du) = 0$ and $E(du)^2 = \sigma_u^2 dt$. Note that $dY$ indicates the flow of production, instead of $Y$, as is ordinarily done in stochastic calculus. We abstract from government in the model for simplicity.

All $j$ firms face identical production conditions and shocks. Thus all firms will choose the same level of employment and capital stock, i.e., $K_j = K$ and $1 - l_j = 1 - l$ for all $j$, where $1 - l$ is the average economy-wide level of employment. Aggregate average capital creates an externality and in equilibrium, when $K_j = K$, aggregate average production is linear in aggregate average capital stock according with an $AK$ production function$^{15}$:

$$dY = A (1 - l)^{\alpha} K (dt + du) \equiv \Omega K (dt + du), \quad (2)$$

where $\Omega \equiv A (1 - l)^{\alpha}$ and $\partial \Omega / \partial (1 - l) > 0$. We assume, for simplicity, that there is no government.

The wage rate, $dZ$, is determined over the period $(t, t+dt)$ according to the marginal product of labor over that period:

$$dZ = z (dt) = \left( \frac{\partial (dY)}{\partial (1 - l_i)} \right)_{K_j = K; l_j = l} (dt), \quad (3)$$

where:

$$z = \alpha A (1 - l)^{\alpha-1} K = \alpha \Omega (1 - l)^{-1} K \equiv wK, \quad (4)$$

and the wage rate is fixed at the start of the period nonstochastically.

The private rate of return to capital, $dR_K$, over the period $(t, t+dt)$ is then determined residually by:

$$dR_K = \frac{dY - (1 - l) dZ}{K} = r_K dt + du_K, \quad (5)$$

where:
\[ r_K \equiv \left( \frac{\partial (dY_i)}{\partial K_i} \right)_{K_j=K,l_j=l} = (1 - \alpha) \Omega \] (6)

and
\[ du_K \equiv \Omega du. \] (7)

The portfolio of the representative agent is also invested in foreign traded bonds, \( B^*_i \), which are assumed to be perpetuities, the price of which is \( E \) in terms of the traded good. The price of bonds is assumed to follow a geometric Brownian motion:
\[ \frac{dE}{E} = \varepsilon dt + de, \] (8)

where \( \varepsilon \) is the instantaneous exogenous expected rate of change in the relative price of the good and \( de \) is an increment of the stochastic process \( e \). These increments are temporally independent and normally distributed. They satisfy \( E(de) = 0 \) and \( E(de)^2 = \sigma^2 dt \). They are assumed to be exogenously given in a small open economy. A key feature of the model is that the domestic economy has access to international financial markets: the domestic interest rate is equal to the exogenous foreign real interest rate, \( i^* \), plus a term depending on the aggregate net foreign asset position of the country, \( E \times B^* \), adjusted by the level of aggregate domestic wealth, \( W \), and the degree of borrowing constraints (financial, ...) the country faces when lending or borrowing, denoted by \( \rho \), through a lending/borrowing function, \( \varphi \left( \rho \frac{EB^*}{W} \right) \), which is assumed to be strictly increasing and convex.\(^{16}\) Note that this cost is exogenously given for the atomistic representative agent. For a creditor country, the real rate of return for foreign bonds expressed in terms of the traded good as the numeraire, \( dR_F \), is equal to:
\[ dR_F = r_F dt + du_F; r_F \equiv i^* + \varepsilon - \varphi \left( \rho \frac{EB^*}{W} \right); du_F \equiv de, \] (9)

where the degree of borrowing constraints, \( \rho \), is exogenously given. The degree of international financial integration, \( i.e. \), the ratio of cross border holdings of assets and liabilities to domestic wealth, is captured by the term

\( \rho \), where the higher the degree of international financial integration, the lower the value of the term \( \rho \). For simplicity, the stochastic shocks \( du \) and \( de \) are assumed to be uncorrelated. We will assume a creditor country throughout.

For the case of a debtor country, then \( D_i^* = -B_i^* \), and the real return for foreign bonds is then given by:

\[
\begin{align*}
dR_F &= r_F dt + du_F; r_F \equiv i^* + \varphi \left( \rho \frac{ED^*}{W} \right); du_F \equiv de, \\
\varphi (0) &= 0; \varphi_t \left( \rho \frac{ED^*}{W} \right) > 0, \varphi_{tt} \left( \rho \frac{ED^*}{W} \right) > 0.
\end{align*}
\]

Results for debtor countries will be conveniently shown in due course.

The representative agent’s wealth constraint will thus be:

\[
W_i = K_i + EB_i^*,
\]

where \( W_i \) is real wealth and is expressed in terms of the numeraire. If we define the following variables for the domestic representative agent,

\[
\begin{align*}
n_{K_i} &\equiv \frac{K_i}{W_i} = \text{share of the domestic portfolio in the form of domestic capital, and} \\
n_{F_i} &\equiv \frac{EB_i^*}{W_i} = \text{share of the domestic portfolio in the form of foreign bonds.}
\end{align*}
\]

Equation (11) for the domestic wealth can be expressed more conveniently, if we divide by \( W_i \) then:

\[
1 = n_{K_i} + n_{F_i}.
\]

The representative agent \( i \) chooses his rate of consumption, \( C_i/W_i \), portfolio shares, \( n_{K_i} \) and \( n_{F_i} \), and leisure, \( l_i \), to maximize his lifetime utility:

\[
E_0 \int_0^\infty \frac{1}{\gamma} (C_i l_i^0)^\gamma e^{-\beta t} dt,
\]

\[-\infty < \gamma < 1; \eta, \theta > 0; \gamma \eta, \gamma \theta < 1.\]

subject to his own rate of wealth accumulation:
\[dW_i = \{(1 - l_i) wK + r_K K_i \\
+ \left[i^* + \varepsilon - \varphi \left(\frac{EB^*_i}{W}\right)\right] (EB^*_i) - C_i \} dt \\
+ \{K_i du_K + (EB^*_i) de\}, \quad (14)\]

where the domestic representative agent consumes at a deterministic rate \(C(t)dt\) in the instant \(dt\).

Then the dynamic budget constraint for the representative agent, (14), is expressed by the following:

\[\frac{dW_i}{W_i} = \psi_i dt + dw_i, \quad (15)\]

and the deterministic and stochastic parts of the rate of growth of assets, \(dW_i/W_i\), can be expressed as:

\[\psi_i \equiv (1 - l_i) w n_K \frac{1}{\omega_i} + r_K n_K_i \\
+ [i^* + \varepsilon - \varphi (\rho n_F)] n_F - \frac{C_i}{W_i} \quad (16)\]

\[dw_i = n_K_i du_K + n_F de, \quad (17)\]

where \(\omega_i = \frac{W_i}{W}\) is the share of individual \(i\)'s domestic wealth \(W_i\) in the total stock of capital \(W\), which will not change over time, because the domestic wealth of all individuals grow at the same rate, as we show below.

Aggregate wealth is then given by:

\[\frac{dW}{W} = \psi dt + dw, \quad (18)\]

where the deterministic and stochastic parts of the rate of growth of assets, \(dW/W\), can be expressed as:

\[\psi \equiv (1 - l) w n_K + r_K n_K \\
+ [i^* + \varepsilon - \varphi (\rho n_F)] n_F - \frac{C}{W} \quad (19)\]

\[dw = n_K du_K + n_F de. \quad (20)\]
This optimization is a two-state variable problem. The first state variable is agent $i$’s wealth, $W_i$, which follows equations (15), (16), and (17), and the second state variable is aggregate wealth, $W$, which follows equations (18), (19), and (20), and is perceived as exogenous by agent $i$.

The macroeconomic equilibrium is derived in Appendix A. The first order conditions can be represented as:

$$\frac{C_i W_i}{\sigma_{w_i}^2} = \frac{\beta - \gamma \{(1 - \alpha) A (1 - l)^{\alpha} n_{K_i} + \alpha A (1 - l)^{\alpha} n_{K_i}\}}{(1 - \gamma)} + \frac{-\gamma \{i^* + \varepsilon - \varphi (\rho n_F)\} n_{F_i} + 0.5 \gamma (1 - \gamma) \sigma_{w_i}^2}{(1 - \gamma)}$$

$$\frac{C_i W_i}{\sigma_{w_i}^2} = \frac{\alpha A (1 - l)^{\alpha - 1} l_i n_{K_i}}{\sigma_{w_i}}$$

$$n_{K_i} = \frac{(1 - \alpha) A (1 - l)^{\alpha} - [i^* + \varepsilon - \varphi (\rho n_F) - \rho \varphi \rho (\rho n_F) + (1 - \gamma) \Delta]}{\rho \varphi \rho (\rho n_F) + (1 - \gamma) \Delta}$$

where

$$\sigma_{w_i}^2 = A^2 (1 - l)^{2\alpha} n_{K_i}^2 \sigma_u^2 + n_{F_i}^2 \sigma_e^2,$$

$$\Delta = A^2 (1 - l)^{2\alpha} \sigma_u^2 + \sigma_e^2.$$

Equations (21), (22), and (23) correspond to equations (72), (70), and (71) in Appendix A. These are typical equations in stochastic models over continuous time. Equations (21) indicates that, at the optimum, the marginal utility derived from consumption must be equal to the marginal change in the value function (or the marginal utility of wealth), equation (22) equalizes the marginal utility derived from consumption and the marginal utility of leisure, and equation (23) indicates that the optimal choice of the domestic portfolio in the form of domestic capital, i.e., $n_{K_i}$, must be such that the risk-adjusted rates of returns for both assets, domestic capital and foreign bonds, are equalized. Then the optimal choice of the domestic portfolio in the form of foreign bonds, i.e., $n_{F_i}$, is defined by equation (12).

Now it is convenient to analyze the impact of financial globalization on the share of the domestic portfolio in the form of domestic capital, $n_{K_i}$, which will help us to study its impact on inequality below. However, the solution is not simple in general, given the structure of equilibrium, as captured by
equations (21), (22), and (23). Totally differentiating equation (23) with respect to the parameter capturing the degree of borrowing constraints \( \rho \), for the case that utility is logarithmic, we get:

\[
\frac{\partial n_K}{\partial \rho} = \frac{n_F [2 \varphi' (\rho n_F) + \rho n_F \varphi'' (\rho n_F)]}{2 \rho \varphi' (\rho n_F) + n_F \rho^2 \varphi'' (\rho n_F) + \Delta + \Gamma},
\]

(25)

where:

\[
\Gamma = - \frac{(1 - l) l}{n_K (1 - \alpha l)} \left[ (1 - \alpha) \alpha A (1 - l)^{\alpha - 1} - 2 n_K (1 - \gamma) \alpha A^2 (1 - l)^{2 \alpha - 1} \sigma_u^2 \right].
\]

(26)

The sign for result (25) is ambiguous.

However, if labor is inelastic, *i.e.*, \( \alpha = 0 \), then \( \Gamma = 0 \), and we get:

\[
\frac{\partial n_K}{\partial \rho} \bigg|_{\alpha=0} = \frac{n_F [2 \varphi' (\rho n_F) + \rho n_F \varphi'' (\rho n_F)]}{2 \rho \varphi' (\rho n_F) + n_F \rho^2 \varphi'' (\rho n_F) + \Delta} > 0.
\]

(27)

The result in (27) means that an increase in borrowing constraints, \( \rho \), increases the share of domestic capital into domestic wealth, because it increases the cost of lending and investing abroad, which in turn makes domestic investment more attractive in the domestic portfolio. On the contrary, a reduction in borrowing constraints associated to financial globalization reduces (increases) the value of the portfolio share in the form of domestic capital (foreign bonds). This is the case for creditor countries.\(^{17}\) For debtor countries, it is straightforward to show a similar result, rearranging the model based on equation (10). Intuitively, when a debtor country is financing domestic investment borrowing from abroad, an increase in borrowing constraints, \( \rho \), increases the cost of borrowing from abroad to invest domestically, which, in turn, will increase (reduce) the value of the portfolio share in the form of domestic capital (foreign bonds). Put simply, when borrowing constraints \( \rho \) increase, the creditor (debtor) country becomes less creditor (debtor), thus exhibiting mean reversion, whereas when \( \rho \) falls, creditor (debtor) countries become more creditor (debtor), thus diverting from the mean.

Instead, when labor is elastic, *i.e.*, \( \alpha \neq 0 \) and \( \Gamma \neq 0 \), result (27) does not necessarily hold, because when borrowing constraints increase and domestic investment becomes more attractive, thus choosing a higher the share

\(^{17}\)Note that the model was solved for a creditor country; see equation (9) above.
of domestic capital into domestic wealth, the amount of time dedicated to leisure falls (or the amount dedicated to labor increases). This, in turn, also makes domestic investment more attractive due to higher returns, but induces a smaller change on the portfolio share of domestic capital into domestic wealth, thus weakening the impact captured by result (27). Therefore, the sign of the result in (25) is ambiguous now. However, to the extent that labor is highly inelastic, result (27) will dominate.

Finally, it is convenient to analyze the relationship between labor/leisure and individual wealth before focusing on inequality. Thus substituting individual consumption-wealth ratio [equation (22)] into the individual growth rate [equation (16)], the supply of leisure for individual \( i \) is:

\[
l_i = \frac{\eta}{1 + \eta} \left[ 1 + \frac{\{(1 - \alpha) A (1 - l)^\alpha n_{Ki} + [i^* + \varepsilon - \varphi (\rho n_F)] n_{Fi} - \psi \} \frac{\omega_i}{n_{Ki}}}{\alpha A (1 - l)^{\alpha-1} (1 + \eta)} \right].
\]  

(28)

Note that relatively wealthier individuals, \( \omega_i > 1 \), would enjoy more leisure: relatively wealthier individuals would achieve higher growth rates, which would be exactly counterbalanced by working less, so that the growth rate does not eventually change.

Given that the growth rate is the same for all individuals, individual leisure supplies are linear in the wealth shares of individuals. Then the aggregate average leisure supply is defined as.

\[
l = \frac{\sum_{i=1}^{N} l_i}{N}.
\]  

(29)

Thus substituting equation (28) for individual leisure in equation (29), aggregate average leisure becomes:

\[
l = \frac{\eta}{1 + \eta} \left[ 1 + \frac{\{(1 - \alpha) A (1 - l)^\alpha n_{Ki} + [i^* + \varepsilon - \varphi (\rho n_F)] n_{Fi} - \psi \} \frac{1}{n_{Ki}}}{\alpha A (1 - l)^{\alpha-1} (1 + \eta)} \right].
\]  

(30)

Then combining equations (28) and (30), the “relative labor supply” can be derived as:

\[
l_i - l = (\omega_i - 1) \left\{ l - \frac{\eta}{1 + \eta} \right\}.
\]  

(31)

\[18\]There is also an additional effect through higher risk, which would make domestic investment not so attractive, thus weakening this effect and reinforcing the effect captured by result (27).
Equation (31) shows a positive relationship between relative wealth and leisure, which will be dealt in Section 2. This is also the result obtained by García-Peñalosa and Turnovsky (2006), except for the inclusion now of individual relative wealth endowment instead of only relative domestic capital endowment.\footnote{As in Equation (15’’) in García-Peñalosa and Turnovsky (2006). It is easy to show that \( l > \frac{\eta}{1+\eta} \).} Equation (31) plays a key role on the mechanism by which the degree of borrowing constraints or risk or other variables impact on the distribution of income, given the initial endowment of wealth across agents.

The transversality condition:

\[
\lim_{t \to \infty} E[V(W_i, W)e^{-\beta t}] = 0, \tag{32}
\]

which guarantees that the value function converges, is satisfied, as shown in Appendix A. This, in turn, is equivalent to satisfying the feasibility condition that consumption-wealth ratio is positive, \( i.e., C/W > 0 \). The convergence of the value function, together with a constant portfolio share in (23), implies that domestic capital and foreign bonds satisfy transversality conditions as well.

Note that the equilibrium values for the portfolio shares, which are constant as specified by equations (23) and (12), imply a key condition for the initial asset composition, because the ratio of portfolio shares is equal to the ratio of the initial stock of foreign bonds, \( b_i \), relative to the initial stock of domestic capital, \( k_i \), \( i.e., \)

\[
\frac{n_F}{n_K} = \frac{b_i}{k_i}. \tag{33}
\]

Thus if initial relative endowment does not satisfy the ratio of portfolio shares specified by equation (33), we assume that the government engages in an initial trade, so that this ratio is achieved.

2 The distribution of income in an open economy

To analyze how income is distributed in an open economy, we focus on the expected relative income for an individual with relative wealth \( \omega_i = \frac{W_i}{W} \), which is a weighted average of her relative endowment of domestic capital,
The expected gross income for an individual is $E(Y_i) = rK_i + wK_i (1 - l_i) + [i^* + \varepsilon - \varphi (\rho EB_i^*)] (EB_i^*)$, and her expected average income is $E(Y) = r_K K + wK (1 - l) + [i^* + \varepsilon - \varphi (\rho EB^*)] (EB^*)$. The expected relative income of individual $i$ is then defined as:

$$y_i = \frac{E(Y_i)}{E(Y)}.$$  \hspace{1cm} (35)

Then substituting equation (28) for individual labor in equation (35), the expected relative income of individual $i$ was:

$$y_i = (1 - \alpha) k_i + \alpha - \frac{\alpha(\omega_i - 1)}{1 - l} \left[ \frac{i(1+\eta)-\omega_i}{1+\eta} \right] + \frac{[i^* + \varepsilon - \varphi (\rho EB_i^*)] (EB_i^*)}{A(1 - l)^\alpha K},$$

which can be expressed, after some algebra, as:

$$y_i = 1 - \frac{[(1 - k_i) - \alpha n_F (b_i - k_i)] \left\{ 1 - \frac{\alpha}{(1 + \eta)(1 - l)} \right\} + \frac{[i^* + \varepsilon - \varphi (\rho n_F)] n_F}{A(1 - l)^\alpha n_K}}{1 + \frac{[i^* + \varepsilon - \varphi (\rho n_F)] n_F}{A(1 - l)^\alpha n_K}}.$$  \hspace{1cm} (37)

Equation (37) indicates that the distribution of income depends on various factors.

On the one hand, we find that the distribution of income depends on the initial distribution of capital $k_i$ and the aggregate average leisure $l$, as emphasized by García-Peñalosa and Turnovsky (2006) for a closed economy, i.e., $n_K = 1$, and $n_F = 0$. Then the expected relative income of individual $i$ is:

$$y_i = 1 - (1 - k_i) \left\{ 1 - \frac{\alpha}{(1 + \eta)(1 - l)} \right\}.$$  \hspace{1cm} (38)

A typical way to measure income inequality is by the standard deviation of relative income, $\sigma_y$, which can be expressed in terms of the standard deviation of the initial endowments of domestic capital, i.e., $\sigma_k$, as shown by equation (38). The result in equation (38) implies that the variability of income across
individuals, i.e., $\sigma_y$, is less than the initial variability of capital endowments across individuals, i.e., $\sigma_k$.\footnote{See equation (18') in García-Peñalosa and Turnovsky (2006).} This can be seen from:

$$\frac{\sigma_y}{\sigma_k} = 1 - \frac{\alpha}{(1 + \eta)(1 - \lambda)},$$

(39)

which lies between 0 and 1.

However, in an open economy, i.e., $n_K \neq 1$, how the variability of initial endowments impacts on the variability of income can be analyzed focusing on the relative endowments of domestic capital and foreign bonds, which are determined, in turn, by equations (23), (12), and (33). Now the standard deviation of relative income, $\sigma_y$, can be expressed, from result (37), in terms of the standard deviation of initial endowments of domestic capital, i.e., $\sigma_k$, and foreign bonds, i.e., $\sigma_b$, and their covariances, i.e., $\sigma_{kb}$, given the linearity in relative endowments as captured by (34), as follows:

$$\sigma_y = \left[ \Omega_k^2 \sigma_k^2 + 2 \Omega_k \Omega_b \sigma_{kb} + \Omega_b^2 \sigma_b^2 \right]^{1/2},$$

(40)

where:

$$\Omega_k = \frac{(1 - \alpha n_F_i) \left\{ 1 - \frac{\alpha}{(1 + \eta)(1 - \lambda)} \right\}}{1 + \frac{[i^* + \varepsilon - \varphi(pn_F)]n_F}{A(1 - \lambda)^n n_K}},$$

(41)

$$\Omega_b = \frac{\alpha n_F_i \left\{ 1 - \frac{\alpha}{(1 + \eta)(1 - \lambda)} \right\} + \frac{[i^* + \varepsilon - \varphi(pn_F)]n_F}{A(1 - \lambda)^n n_K}}{1 + \frac{[i^* + \varepsilon - \varphi(pn_F)]n_F}{A(1 - \lambda)^n n_K}}.$$  

(42)

Now a key result in (40) is that for an open economy the variability of income across individuals may be higher than the variability of initial endowments of individuals, as opposed to the results for a closed economy.

In the more simple case where relative endowments of domestic capital and foreign bonds are equal, i.e., $\omega_i = k_i = b_i$, then the expected relative income of individual $i$ in equation (37) is equal to:

$$y_i = \frac{1 - (1 - \omega_i) \left\{ 1 - \frac{\alpha}{(1 + \eta)(1 - \lambda)} \right\} + \frac{[i^* + \varepsilon - \varphi(pn_F)]\omega_i n_F}{A(1 - \lambda)^n n_K}}{1 + \frac{[i^* + \varepsilon - \varphi(pn_F)]n_F}{A(1 - \lambda)^n n_K}}.$$  

(43)

This implies that, for relatively “rich” individuals, i.e., when $\omega_i > 1$, it is easy to show that the relative individual endowment of wealth is higher than...
relative income, i.e., $\omega_i > y_i$, whereas for relatively “poor” individuals, i.e., when $\omega_i < 1$, we can show that the relative individual endowment of wealth is lower than relative income, i.e., $\omega_i < y_i$. This result will be useful below. We can also show from result (37) that:

$$\frac{\sigma_y}{\sigma_\omega} = \left\{1 - \frac{\alpha}{(1+\eta)(1-l)}\right\} + \frac{[i^*+\epsilon-\varphi(\rho n_F)]n_F}{A(1-l)^\alpha n_K},$$

which is between 0 and 1, and it implies that the variability of individual income is lower than the variability of the endowment of initial wealth, as in García-Peñalosa and Turnovsky (2006), but the impact is not identical.

Now, to analyze the impact of financial globalization on inequality, it is convenient to use the expected relative income for an individual as a measure of inequality. We focus on a logarithmic utility function for simplicity. Thus, differentiating equation (37) with respect to the parameter capturing the degree of borrowing constraints $\rho$, we get:

$$\frac{dy_i}{d\rho} = \frac{\partial y_i}{\partial n_K} \left[ \frac{\partial y_i}{\partial n_K} - \frac{(1-l)l}{n_K (1-\alpha l)} \frac{\partial y_i}{\partial l} \right],$$

where $\frac{\partial y_i}{\partial n_K}$ is given by result (25), and:

$$\frac{\partial y_i}{\partial n_K} = \frac{(k_i - b_i) \left[ 1 - \frac{\alpha}{(1+\eta)(1-l)} \right] + (y_i - b_i) \frac{[i^*+\epsilon-\varphi(\rho n_F)]}{A(1-l)^\alpha n_K}}{1 + \frac{[i^*+\epsilon-\varphi(\rho n_F)]n_F}{A(1-l)^\alpha n_K} n_K}$$

$$\frac{\partial y_i}{\partial l} = \frac{\alpha}{(1+\eta)(1-l)^\alpha} \left[ (1-k_i) - \alpha n_F (k_i - b_i) \right] + \left( y_i - b_i \right) \frac{\alpha [i^*+\epsilon-\varphi(\rho n_F)] n_K}{A(1-l)^\alpha n_K}.$$

The result in (45) implies that when labor is inelastic, i.e., $\alpha = 0$, if we combine (27), (46), and (47), we get:

$$\frac{\partial y_i}{\partial \rho} < 0$$

i.e., relaxing borrowing constraints will be unambiguously associated to higher inequality, when individual relative endowment for foreign bonds is higher than that for domestic capital, i.e., $b_i > k_i$, and individual relative endowment for foreign bonds is higher than individual relative income, i.e., $b_i > y_i$. 18
For the rest of the cases the result will depend on which of these effects dominate. When labor is elastic, the result becomes more ambiguous because portfolio adjustment is accompanied by labor adjustment, which, in turn, weakens the impact of relaxing borrowing constraints on portfolio shares.

Now, in the case where relative endowments of domestic capital and foreign bonds are equal, i.e., $\omega_i = k_i = b_i$, the derivatives associated to result (45) become, respectively:

\[
\frac{\partial y_i}{\partial n_K} = \frac{(y_i - \omega_i) \left[ i^* + \epsilon - \varphi(\rho_n F) \right]}{1 + \left[ i^* + \epsilon - \varphi(\rho_n F) \right] \frac{n_F}{n_K}} \quad (49)
\]

\[
\frac{\partial y_i}{\partial l} = \frac{\alpha}{(1+\eta)(1-l)^2} \left( 1 - k_i \right) + (y_i - \omega_i) \frac{\alpha \left[ i^* + \epsilon - \varphi(\rho_n F) \right] n_K}{A(1-l)^\gamma n_F} \frac{n_F}{n_K} \quad (50)
\]

Then, when labor is inelastic, i.e., $\alpha = 0$, combining results (27), (49) and (50), we find that, for “rich” individuals, i.e., $\omega_i > 1$, and $\omega_i > y_i$, the result (45) implies that:

\[
\frac{dy_i}{d\rho} < 0, \quad (51)
\]

whereas for “poor” individuals, i.e., $\omega_i < 1$, and $\omega_i < y_i$, it implies that:

\[
\frac{dy_i}{d\rho} > 0, \quad (52)
\]

that is, a lower value of the parameter capturing borrowing constraints, or an increase in the degree of financial globalization, will make relatively rich individuals even richer, and relatively poor individuals even poorer. The intuition behind the result is that higher financial globalization makes investing in foreign bonds more attractive, which, given that richer individuals have higher relative endowments of wealth (foreign bonds), makes rich individuals even richer, and vice versa. When labor is elastic, i.e., $\alpha \neq 0$, these results becomes more ambiguous, because then the impact of an increase in the degree of financial globalization on the portfolio share is weakened by the adjustment in labor, as captured by the term (26) in (25), and the term (50) in (45).

Finally, the influence of risk on inequality is analyzed. The impact of changes in domestic volatility $\sigma_u^2$ on inequality is obtained for the logarithmic
case differentiating equation (37) with respect to domestic volatility, $\sigma_u^2$:

$$\frac{dy_i}{d\sigma_u^2} = \frac{\partial n_K}{\partial \sigma_u^2} \left[ \frac{\partial y_i}{\partial n_K} - \frac{(1-l)l}{n_K(1-\alpha l)} \frac{\partial y_i}{\partial l} \right], \quad (53)$$

where:

$$\frac{\partial n_K}{\partial \sigma_u^2} = \frac{-n_K A^2 (1-l)^{2\alpha}}{2 \rho \varphi_l (\rho n_F) + \rho^2 n_F \varphi_u (\rho n_F) + \Delta + \Gamma}, \quad (54)$$

and $\frac{\partial y_i}{\partial n_K}$, $\frac{\partial y_i}{\partial l}$, and $\Gamma$ are given by results (46), (47), and term (26) above, respectively. The result (53) suggests that when labor is inelastic, \( i.e., \alpha = 0, \) then $\frac{\partial n_K}{\partial \sigma_u^2} < 0$ and higher domestic volatility will be associated to higher inequality when either individual relative endowment for foreign bonds is higher than that for domestic capital, \( i.e., b_i > k_i, \) and individual relative endowment for foreign bonds is higher than individual relative income, \( i.e., b_i > y_i. \) Again the result will depend in general on which of these effects dominate. Furthermore, when relative endowments of domestic capital and foreign bonds are equal, \( i.e., \omega_i = k_i = b_i, \) higher domestic volatility will be associated to higher inequality, that is, for rich individuals, \( i.e., \omega_i > 1, \) and $\omega_i > y_i$, the result (53) implies that $\frac{dy_i}{d\sigma_u^2} > 0$, and for poor individuals, \( i.e., \omega_i < 1, \) and $\omega_i < y_i$, it implies that $\frac{dy_i}{d\sigma_u^2} < 0$, so that rich people get richer and poor people get poorer. Intuitively, higher domestic volatility makes investing in foreign bonds more attractive, which, given that richer individuals have higher relative endowments of wealth (foreign bonds), makes rich individuals even richer, and vice versa. Again, when labor is elastic, results become more ambiguous due to the adjustment taking place in labor.

The impact of external volatility $\sigma_e^2$ on inequality can be analyzed differentiating equation (37) with respect to external volatility, $\sigma_e^2$. When utility is logarithmic, we get:

$$\frac{dy_i}{d\sigma_e^2} = \frac{\partial n_K}{\partial \sigma_e^2} \left[ \frac{\partial y_i}{\partial n_K} - \frac{(1-l)l}{n_K(1-\alpha l)} \frac{\partial y_i}{\partial l} \right], \quad (55)$$

where:

$$\frac{\partial n_K}{\partial \sigma_e^2} = \frac{(1-\gamma) n_F}{2 \rho \varphi_l (\rho n_F) + \rho^2 n_F \varphi_u (\rho n_F) + \Delta + \Gamma}, \quad (56)$$

and $\frac{\partial y_i}{\partial n_K}$ and $\frac{\partial y_i}{\partial l}$, and $\Gamma$ are given by results (46), (47), and term (26), respectively. Intuitively, the result (56) means that when labor is inelastic,
i.e., $\alpha = 0$, for creditor countries, higher external volatility will be associated to higher inequality when either individual relative endowment for domestic capital is higher than that for foreign bonds, i.e., $k_i > b_i$, and individual relative income is higher than individual relative endowment for foreign bonds, i.e., $y_i > b_i$. The result will depend in general on which of these effects dominate. When relative endowments of domestic capital and foreign bonds are equal, i.e., $\omega_i = k_i = b_i$, higher external volatility will be associated to lower inequality, because higher external volatility makes investing in foreign bonds less attractive, which, given that richer individuals have higher relative endowments of wealth (foreign bonds), makes rich individuals poorer, and vice versa. Again, when labor is elastic, results become more ambiguous.

3 Data sources and empirical evidence

The data on updated international investment positions have been obtained from Lane and Milesi-Ferretti (2007). Total external assets and liabilities include the stock of direct investment plus portfolio equity, portfolio debt investment, other investment assets (e.g., general government, banks), reserve assets (minus gold) and financial derivatives. The net foreign asset position is equal to total external assets minus total external liabilities. Capital stocks has been obtained from International Monetary Fund’s “Investment and Capital Stock Dataset, 1960-2015”. To get comparable nominal domestic capital stocks, capital-output ratios have been calculated first from their values in real terms, and then these ratios have been multiplied by current GDP from the World Bank’s World Development Indicators (WBWDI) to obtain the stocks of domestic capital in current US dollars. Then domestic wealth is obtained adding up the net foreign asset position. The remaining other variables are provided directly by the WBWDI.

Data on inequality can be obtained from different sources and methodologies. In this paper we are inclined to employ inequality data based on Branko Milanovic’s “All the Ginis” (ATG) database, as argued in the Introduction. ATG provides Gini coefficients based on the three possible type of characteristics of the result. First, the Gini coefficient can be an income- or consumption-based measure. Second, it can be based on data provided by

\[\text{March 2017 version.}\]
\[\text{January 2017 version.}\]
\[\text{October 2016 version.}\]
individuals or households. Third, the Gini coefficient can be obtained from gross (before tax) or net (after tax) magnitudes. It is not easy to handle such differences on Gini coefficients. Thus we take as the benchmark case the most common concept of Gini coefficient, which is based on income data, based on individuals, and expressed in net terms. Then we create dummy variables to take into account differences in Gini coefficients due to different methodologies. Thus, if Gini coefficient is consumption-based, then dummy $D_c = 1$, but $D_c = 0$ otherwise (i.e., income based). If Gini coefficient is household-based, then dummy $D_{hh} = 1$, but $D_{hh} = 0$ otherwise (i.e., individual-based). Finally, if Gini coefficient is based on gross terms, then dummy $D_g = 1$, but $D_g = 0$ otherwise (i.e., based on net terms). These dummy variables would capture differential level-effects of financial globalization on inequality, which would add more accuracy to the estimation. However, this may not be sufficient. That is why we also introduce country and year effects to further capture possible differences across countries and years. Note that we use annual data in this paper to maximize the sample size and to estimate parameters more precisely.

The dataset employed in this paper to test the main results of the model, as shown in Section 2, encompasses 106 countries, as exhibited in Table B, from 1970 to 2015.

We will capture the increase in cross border holdings of capital through a measure of international financial integration, $IFI$, which refers to the ratio of the sum of total external assets plus total external liabilities with respect to domestic wealth. Now the impact of international financial integration, $IFI$, on inequality can be tested with the following regression equation:

$$\text{Inequality}_{ct} = a_0 + a_1 \times IFI_{ct} + a_2 \times IFI^2_{ct} + a_3 \times D_{cct} + a_4 \times D_{hct} + a_5 \times D_{gct} + u_{ct},$$

Note that, in terms of the ATG database, the benchmark case implies that $D_i=1$, $D_h=0$, and $D_g=0$.

See Baltagi, Demetriades and Law (2009). It is convenient for this approach to allow for the dynamics in the behavior of the dependent variable, which may capture partial adjustment towards the steady state. That is why we will introduce a lagged dependent variable on the right hand side when we employ a dynamic Generalized Method of Moments (GMM) for the estimation, as we detail below. This method allows to get rid of any country specific time-invariant variable. We also employ cross section and fixed effects estimation, even though it is biased in dynamic panels. The empirical growth, and inequality, literature has usually averaged the data over horizons spanning five or ten years.

This has been adapted from Lane and Milesi-Ferretti (2003); see Erauskin (2013).
where

\[ D_c = 1, \text{ if data is consumption based, } 0 \text{ otherwise}, \]
\[ D_{hh} = 1 \text{ if data is household based, } 0 \text{ otherwise}, \]
\[ D_g = 1 \text{ if data is based on gross income, } 0 \text{ otherwise}. \]

and \( u_{ct} \) is the error term, for country \( c \) in period \( t \) in all cases. The coefficient \( a_1 \) captures the impact of financial globalization on inequality in the benchmark case. We also include a quadratic term on financial globalization, i.e., \( a_2 \), to capture possible non-linear effects. Coefficients from \( a_3 \) to \( a_5 \) capture the additional (differential) impact of financial globalization on inequality due to different methodologies, namely those based on consumption data, on households, and on gross terms, respectively. We include control variables, such as the level of output per capita and the degree of trade openness (measured as the sum of exports and imports with respect to GDP). We also include quadratic terms on output per capita and trade openness to allow for possible non-linear effects on inequality. Country and time dummies have also been added to the regression in some specifications. We test the regression equation (57) for all values of the degree of financial globalization. The results are exhibited in Table 1 for the pooled estimation by ordinary least squares (OLS) in the first two columns. The first column refers to the basic estimation without control variables and without country and time dummies, whereas the second column includes controls and dummies.\(^{27}\) The third and fourth columns shows analogous results for the fixed effects estimation (FE), without controls and country and time dummies variables, or with them, respectively. Fixed effect estimation allows for free correlation among the additive, unobserved heterogeneity and the explanatory variables. Furthermore, despite the fixed effect estimation is somewhat restrictive because heterogeneity is assumed to be additive and to have constant coefficients; this allows robust estimates with the presence of country-specific slopes on the country-specific covariates.\(^{28}\) We find that, despite in the simplest setup (first column), financial globalization seems to be negatively associated to inequality (but it is not significant though), in the most complete case, a higher degree of financial globalization is positively and significantly associated to a higher degree of inequality, with differing degrees of significance.

\(^{27}\)Robust standard errors are clustered by country.
\(^{28}\)See Wooldridge (2005).
In addition, results in Table 1 suggest that there is a negative (positive) differential effect on inequality when data is based on consumption (household) data, as expected, but the sign of the differential effect on inequality when data is based on gross is unexpectedly negative, but not significant. Higher GDP per capita seems to be associated to higher inequality, whereas trade openness to lower inequality, but coefficients are not significant.

However, international financial integration refers to both domestic holdings of foreign capital and foreign holdings of domestic capital, which are likely to have different impacts on inequality. Furthermore, foreign holdings of domestic capital may probably have a stronger impact on inequality than domestic holdings of foreign capital, given that the impact of the former is likely to have a more direct impact on the performance of the domestic economy through direct investment from abroad, financing projects in the domestic economy, and so on. To capture this differential effect, the impact of financial assets (as a ratio with respect to domestic wealth), \( FA \), and financial liabilities (also as a ratio with respect to domestic wealth), \( FL \), on inequality is tested with the following regression equation:

\[
\text{Inequality}_{ct} = a_0 + a_1 \times FA_{ct} + a_2 \times FA^2_{ct} + a_3 \times FL_{ct} + a_4 \times FL^2_{ct} + a_5 \times Dc_{ct} + a_6 \times Dhh_{ct} + a_7 \times Dg_{ct} + u_{ct},
\]

where

\[
Dc = 1, \text{ if data is consumption based, } 0 \text{ otherwise,}
\]
\[
Dhh = 1 \text{ if data is household based, } 0 \text{ otherwise,}
\]
\[
Dg = 1 \text{ if data is based on gross income, } 0 \text{ otherwise.}
\]

Now coefficients \( a_1 \) and \( a_2 \) capture the (linear and quadratic) impact of the increase of financial assets, \( FA \), on countries’ inequality, whereas \( a_3 \) and \( a_4 \) capture the (linear and quadratic) impact of the increase of financial liabilities, \( FL \), on countries’ inequality, for the benchmark case. Coefficients from \( a_5 \) to \( a_7 \) capture again the additional (differential) impact of the increase of financial assets and liabilities on inequality due to different methodologies. The results for the regression equation (58) are exhibited in Table 2 for the pooled estimation by \( OLS \) in the first two columns and for the \( FE \) estimation in the last two columns. Control variables include output per capita and the degree of trade globalization again, as well as country and time dummies. Now we find that the increase in the volume of financial liabilities seems to
increase inequality, with differing degrees of significance. On the contrary, the increase in the volume of financial assets is suggested to reduce inequality. In addition, we find significant differential effects for consumption and household based data, but not data in gross terms.

Lastly, we also test the impact of the net foreign asset position (as a ratio with respect to domestic wealth), $NFA$, on inequality through the regression equation:

$$Inequality_{ct} = a_0 + a_1 \times NFA_{ct} + a_2 \times NFA^2_{ct} + a_3 \times Dc_{ct} + a_4 \times Dhh_{ct} + a_5 \times Dg_{ct} + u_{ct}, \quad (59)$$

where

- $Dc = 1$ if data is consumption based, 0 otherwise,
- $Dhh = 1$ if data is household based, 0 otherwise,
- $Dg = 1$ if data is based on gross income, 0 otherwise.

Coefficients $a_1$ and $a_2$ capture the (linear and quadratic) impact of the net foreign asset position on country's inequality in the benchmark case and coefficients from $a_3$ to $a_5$ capture the additional (differential) impact of the net foreign asset position on inequality due to different methodologies. The results for the regression equation (59) are exhibited in Table 3 for the pooled estimation by OLS in the first two columns and for the FE estimation in the last two columns. Control variables include output per capita and the degree of trade openness again, as well as country and time dummies. More creditor (debtor) countries seem to be associated to lower (higher) degree of inequality, consistent with earlier results. The impact of the differential effects for consumption and household based data, but not for data in gross terms, and the introduction of control variables is similar to previous regressions.

Finally, to allow for possible endogeneity in the explanatory variables, we use the system Generalized Method of Moments (GMM).\textsuperscript{29} As is well known, when the dependent variable exhibits persistence and the number of time series observations is relatively small, first-difference GMM\textsuperscript{30} may suffer from some estimation bias. Then system GMM may be more efficient than first-difference GMM. We test the three regressions (57), (58), and (59) again. We also include one lagged value of the dependent variable to

\textsuperscript{29}Arellano and Bover (1995) and Blundell and Bond (1998).

\textsuperscript{30}Arellano and Bond (1991).
capture dynamics in those three regressions. All the results, without and with one lagged value of the dependent variable, are shown in Table 4. \[31\] The first-difference GMM estimation is accompanied by the usual diagnostic testing. The first diagnostic test investigates first- and second-order serial correlations in the disturbances. The absence of a first-order serial correlation should be rejected, but the absence of a second-order serial correlation should not. Second, a Hansen test is performed for the null hypothesis that the overidentifying assumptions are valid, which should not be rejected. Both tests are satisfied. We confirm most of the results shown above, except for the impact of international financial integration, which does not seem to be supported for GMM estimation. Thus higher values of financial liabilities (assets) are associated to significantly higher (lower) values of inequality, whereas more creditor (debtor) countries are related to significantly lower (higher) values of inequality. Dummy variables take generally the expected values, but now it is only significant the one capturing the differential impact of data expressed in gross terms. Summarizing, the empirical results obtained appear to be robust to the inclusion of the lagged dependent variable as a regressor.

Finally, we test the impact of income volatility on inequality. There are different approaches to analyze this relationship. We are inclined to employ a long-run approach for this relationship, instead of using panel data analysis, because most of the variation in the dependent variable is between countries rather than variation over time. Thus cross-country analysis is better suited to analyze differences among countries (Breen and García-Peñalosa, 2005). Income volatility is measured as the standard deviation of real GDP growth with respect to its average value during the period 1970-2015. We test the

\[31\] Note that we employ lag one (two) of the dependent variable as instrument, which is the latest one that is valid under the assumptions of the model, when no (one) lagged value of the dependent variable is included in the regression. Thus we use 92-94 instruments for the estimation of the impact of international financial integration, total assets and liabilities, and the net foreign asset position on inequality, which implies that the number of instruments is relatively small with respect to the number of observations. Too many instruments can weaken the Hansen test of the instruments’ joint validity (see Roodman (2009a) for instance). This is the case for year and country dummies, which have not been included in the estimation, because then implausible p-values of 1 are obtained for the Hansen test, but the results would be broadly similar. We have employed xtabond2 command in the estimation, as developed by Roodman (2009b).
relationship between income volatility and inequality with the regression:

\[ \text{Inequality}_{ct} = a_0 + a_1 \times \text{Income Volatility} + a_2 \times \text{Income Volatility}^2 + u_{ct}. \]  
(60)

We find in Table 5 the results over the entire period 1970-2015 for the benchmark case where results are based on income data, based on individuals, and expressed in net terms. In the first column we show the basic relationship in equation (60), in the second column we have added dummy variables capturing differences in results due to different methodologies, such as those based on consumption data, based on households, and expressed in gross terms, as above. The third column also adds per capita GDP as a control variable. We do not find a clear-cut relationship between income volatility and inequality. Furthermore, estimates are not significant. However, different studies suggest that volatility seems to have declined before the Great Recession.\(^{32}\) It is likely that the Great Recession may have exacerbated income volatility. Table 6 confirms this trend: the most recent period has been accompanied by higher volatility. Now we consider two different periods, before and after 2008 and then we test equation (60) for both periods. Table 7 exhibits the results. We find that higher income volatility is associated to higher inequality over the first period 1970-2007, which is significant and robust across specifications. However, these results do not hold for the period 2009-2015, where the sign of the relationship changes to negative and it is not significant either. Therefore, these results confirms our model before the Great Recession, but trends seem to have changed after the Great Recession.

4 Conclusions

This paper has studied the impact of financial globalization and volatility on inequality when countries face borrowing constraints. First, we have shown that the results of the model depend crucially on labor elasticity and relative initial endowments of domestic capital and foreign bonds. We have shown that, when labor is highly inelastic, a higher degree of international financial integration will increase inequality, because higher international financial integration makes investing in foreign bonds more attractive, which, given that richer individuals have higher relative endowments of wealth (foreign bonds),

\(^{32}\)See Doyle and Faust (2005); Kose et al. (2006).
makes rich individuals even richer. Higher domestic volatility would also increase inequality, but higher external volatility would diminish inequality. When labor is highly elastic, the results are more ambiguous because the impact on portfolio shares is weakened by the adjustment of labor. Second, we have found that the main results for the model are broadly supported by the empirical evidence using the most recent data for a sample of 106 countries for the period ranging from 1970 to 2015. We have found that it is not clear that higher financial integration is associated to higher inequality, but we show that a higher level of financial liabilities (assets) is strongly associated to higher (lower) inequality. Furthermore, more indebted countries seems to be associated to higher degrees of inequality. We also find that more domestic volatility seems to be associated to higher inequality. However, the pattern seems to have changed since the Great Recession.

These results suggest that, to the extent that the increase in inequality is not a desirable feature for a country’s performance, public policy should pay special attention to the evolution of cross border holdings of capital. Our model has abstracted from the role of government in a modern market economy, which suggests an interesting avenue for future research to study how government can help to mitigate the adverse effects of financial globalization on inequality.

References


[63] Solt, Frederick, 2015. The Standardized World Income Inequality Database


A Derivation of macroeconomic equilibrium

The first step to solve the optimization problem is to introduce a value function depending on two state variables, \( V(W, W) \), which is defined by the following equation:

\[
V(W, W) = \max_{\{C, nK, l\}} \mathbb{E}_0 \int_0^\infty \frac{1}{\gamma} \left( C_i l^\gamma G^\theta \right)^\gamma e^{-\beta t} dt, \quad (61)
\]

subject to restrictions (15), (16), (17), (18), (19), and given initial individual and aggregate wealth. The value function in period 0 is the expected value of the discounted sum of instantaneous utilities, evaluated along the optimal path, starting in period 0 in states \( W(0) = W_{i,0} \) and \( W(0) = W_0 \).

Second, starting from equation (61) the value function must satisfy the Bellman equation:

\[
\beta V(W, W) = \max_{\{C, nK, l\}} \left[ \frac{1}{\gamma} \left( C_i l^\gamma G^\theta \right)^\gamma + W_i^\gamma W_{i,0}^\gamma + V_W W_i W_{i,0} \right]. \quad (62)
\]

The evolution of individual variables are described by equations (15), (16), and (17) and aggregate variables by equations (18), (19), and (20).

Third, the right side of equation (62) is partially differentiated with respect to \( C_i, l_i, \) and \( nK \) to obtain the first-order optimality conditions of the optimization problem:

\[
C_i^{\gamma-1} l_i^{\gamma-1} G^\theta = V_W W_i \quad (63)
\]

\[
\eta C_i^{\gamma-1} l_i^{\gamma-1} G^\theta = V_W W_i \left[ \alpha A (1 - l)^{\alpha-1} \frac{1}{\omega_i} nK \right] \quad (64)
\]

\[
0 = V_W W_i \left\{ (1 - \alpha) A (1 - l)^{\alpha-1} \left[ l^* + \varepsilon - \varphi (\rho n_F) + n_F \rho \varphi' (\rho n_F) \right] \right\}
- V_W W_i^2 \left\{ A^2 (1 - l)^{2\alpha} nK \sigma_u^2 - n_F \sigma_e^2 \right\}
- V_W W_i^2 \left\{ A^2 (1 - l)^{2\alpha} nK \sigma_u^2 - n_F \sigma_e^2 \right\}, \quad (65)
\]

where the representative agent takes as given the evolution of aggregate variables.

Now we postulate a value function of two state variables:

\[
V(W, W) = F W_i^{\gamma-\gamma_2} W^{\gamma_2}, \quad (66)
\]
where the coefficient $F$ and parameter $\gamma_2$ are determined below. This guess implies that:

$$V_{W_i} = F (\gamma - \gamma_2) W_i^{\gamma - \gamma_2 - 1} W^{\gamma_2},$$
$$V_W = F \gamma_2 W_i^{\gamma - \gamma_2 - 1} W^{\gamma_2 - 1},$$
$$V_{W,W_i} = F (\gamma - \gamma_2) (\gamma - \gamma_2 - 1) W_i^{\gamma - \gamma_2 - 2} W^{\gamma_2},$$
$$V_{W,W} = F \gamma_2 (\gamma_2 - 1) W_i^{\gamma - \gamma_2 - 2} W^{\gamma_2 - 2},$$
$$V_{W_i} = F (\gamma - \gamma_2) \gamma_2 W_i^{\gamma - \gamma_2 - 1} W^{\gamma_2 - 1}. \quad (67)$$

Setting the equilibrium conditions, \textit{i.e.}, individual and aggregate portfolio shares are equal, we get:

$$n_{K_i} = n_K; \quad n_{F_i} = n_F; \quad (68)$$

Inserting these equilibrium expressions (67), and (68) into the first order optimality conditions (63), (64) and (65) we obtain:

$$\frac{C_i}{W_i} = \left[ \frac{F \gamma}{l_i^{\eta \theta}} \right]^{\frac{1}{\gamma - 1}} \quad (69)$$

$$\frac{C_i}{W_i} = \frac{\alpha A (1 - l)^{\alpha - 1} l_i n_{K_i}}{\eta \omega_i} \quad (70)$$

$$n_{K_i} = \frac{\rho \varphi t (\rho n_F) + (1 - \gamma) [A^2 (1 - l)^{\alpha} \sigma_u^2 + \sigma_e^2]}{\rho \varphi t (\rho n_F) + (1 - \gamma) [A^2 (1 - l)^{\alpha} \sigma_u^2 + \sigma_e^2]} \quad \eta \omega_i \quad (71)$$

Substituting equation (69) into equation (62) and setting equilibrium conditions we get the equilibrium consumption-wealth ratio:

$$\frac{C_i}{W_i} = \frac{\beta - \gamma \{(1 - \alpha) A (1 - l)^{\alpha} n_{K_i} + \alpha A (1 - l)^{\alpha} n_{K_i}\}}{(1 - \gamma)}$$

$$+ \frac{-\gamma \{i^* + \varepsilon - \varphi (\rho n_F)\} n_{F_i} + 0.5 \gamma (1 - \gamma) \sigma_w^2}{(1 - \gamma)} \quad (72)$$

These are typical equations in stochastic models over continuous time. Equations (69) indicates that, at the optimum, the marginal utility derived from consumption must be equal to the marginal change in the value function (or the marginal utility of wealth), equation (70) equalizes the marginal
utility derived from consumption and the marginal utility of leisure, and
equation (71) shows that the optimal choice of portfolio shares by the repre-
sentative agent must be such that the risk-adjusted rates of returns for both
assets, domestic capital and foreign bonds, are equalized.

The transversality condition to guarantee the convergence of the value
function is:

$$\lim_{t \to \infty} E[V(W_i, W) e^{-\beta t}] = 0. \tag{73}$$

To evaluate equation (73), we express the dynamics of the accumulation of
individual and aggregate wealth by equations (15) and (18), respectively. The
solutions to equations (15) and (18), starting from the initial individual and
aggregate wealth, $W_i(0)$ and $W(0)$, are given by the following equations:

$$W_i(t) = W_i(0)e^{[\psi - 0.5\sigma^2_w]t + w(t)}.$$  
$$W(t) = W(0)e^{[\psi - 0.5\sigma^2_w]t + w(t)}.$$ 

Because the increments of $w$ are temporally independent and are normally
distributed, then we have the following equations:

$$E\left[FW_i\gamma_{-\gamma} W_{\gamma} e^{-\beta t}\right] = E\left[FW_i(0)^{\gamma_{-\gamma}} W(0)^{\gamma} e^{[\psi - 0.5\sigma^2_w]t + \gamma w(t) - \beta t}\right].$$  

The transversality condition (73) will be satisfied if and only if:

$$\gamma [\psi - 0.5(1 - \gamma) \sigma^2_w] < \beta. \tag{74}$$

Now substituting equations (19) and (72), this condition (74) is equivalent to:

$$\frac{C}{W} > 0, \tag{75}$$

and, therefore, satisfying the feasibility condition is also equivalent to satis-
fying the transversality condition, which guarantees convergence.\(^{34}\)

B List of countries

1. Developed OECD countries: Australia, Austria, Belgium, Canada,
   Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece,


\(^{34}\)See Merton (1969) and Turnovsky (2000a).
Iceland, Ireland, Italy, Japan, Republic of Korea, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

2. Other high income countries: Croatia, Estonia, Hong Kong, Israel, Lithuania, Poland, Singapore, Slovak Republic, Slovenia, Trinidad and Tobago.

3. Middle income countries: Albania, Algeria, Angola, Argentina, Azerbaijan, Belarus, Belize, Bosnia and Herzegovina, Botswana, Brazil, China, Colombia, Costa Rica, Dominican Republic, Ecuador, Fiji, Gabon, Iran, Kazakhstan, Macedonia FYR, Malaysia, Maldives, Mexico, Namibia, Paraguay, Peru, Russian Federation, South Africa, Suriname, Thailand, Turkey, Uruguay, Venezuela.

4. Middle-Low income countries: Bangladesh, Bhutan, Cape Verde, Djibouti, Egypt, El Salvador, Ethiopia, Guatemala, Honduras, India, Indonesia, Kenya, Lesotho, Mongolia, Morocco, Nigeria, Pakistan, Philippines, Sri Lanka, Swaziland, Tajikistan, Tunisia, Ukraine, Uzbekistan, Yemen, Republic of Zambia.

Table 1: Impact of financial openness on inequality

<table>
<thead>
<tr>
<th>Dependent variable: Inequality (in logs)</th>
<th>Pooled regression</th>
<th>Fixed effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>$IFI [a_1]$</td>
<td>-0.0017</td>
<td>0.0310**</td>
</tr>
<tr>
<td></td>
<td>(0.0188)</td>
<td>(0.0160)</td>
</tr>
<tr>
<td>$IFI^2 [a_2]$</td>
<td>-0.0003</td>
<td>-0.0018</td>
</tr>
<tr>
<td></td>
<td>(0.0012)</td>
<td>(0.0011)</td>
</tr>
<tr>
<td>Dummy: Consumption $[a_3]$</td>
<td>-0.0528</td>
<td>-0.0730**</td>
</tr>
<tr>
<td></td>
<td>(0.0324)</td>
<td>(0.0286)</td>
</tr>
<tr>
<td>Dummy: Household $[a_4]$</td>
<td>-0.0364</td>
<td>0.1025***</td>
</tr>
<tr>
<td></td>
<td>(0.0316)</td>
<td>(0.0287)</td>
</tr>
<tr>
<td>Dummy: Gross Income$[a_5]$</td>
<td>0.2857***</td>
<td>-0.0039</td>
</tr>
<tr>
<td></td>
<td>(0.0292)</td>
<td>(0.0220)</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>0.0018</td>
<td>0.0018</td>
</tr>
<tr>
<td></td>
<td>(0.0044)</td>
<td></td>
</tr>
<tr>
<td>GDP per capita$^2$</td>
<td>-0.0000</td>
<td>-0.0000</td>
</tr>
<tr>
<td></td>
<td>(0.0000)</td>
<td></td>
</tr>
<tr>
<td>Trade openness</td>
<td>-0.0295</td>
<td>-0.0295</td>
</tr>
<tr>
<td></td>
<td>(0.0704)</td>
<td></td>
</tr>
<tr>
<td>Trade openness$^2$</td>
<td>-0.0030</td>
<td>-0.0030</td>
</tr>
<tr>
<td></td>
<td>(0.0142)</td>
<td></td>
</tr>
<tr>
<td>Country and time dummies</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Constant $[a_0]$</td>
<td>3.5255***</td>
<td>3.4042***</td>
</tr>
<tr>
<td></td>
<td>(0.0379)</td>
<td>(0.0677)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.3243</td>
<td>0.8671</td>
</tr>
<tr>
<td>No. of observations</td>
<td>1,360</td>
<td>1,209</td>
</tr>
<tr>
<td>No. of countries</td>
<td>106</td>
<td>103</td>
</tr>
</tbody>
</table>

Robust standard errors clustered by country are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.
Table 2: Impact of financial assets and liabilities on inequality

<table>
<thead>
<tr>
<th>Dependent variable: Inequality (in logs)</th>
<th>Pooled regression</th>
<th>Fixed effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>FA[\alpha_1]</td>
<td>-0.2970**</td>
<td>-0.1237</td>
</tr>
<tr>
<td></td>
<td>(0.1207)</td>
<td>(0.0810)</td>
</tr>
<tr>
<td>FA^2[\alpha_2]</td>
<td>0.0930*</td>
<td>0.0282</td>
</tr>
<tr>
<td></td>
<td>(0.0493)</td>
<td>(0.0295)</td>
</tr>
<tr>
<td>FL[\alpha_3]</td>
<td>0.2555**</td>
<td>0.1468**</td>
</tr>
<tr>
<td></td>
<td>(0.1011)</td>
<td>(0.0667)</td>
</tr>
<tr>
<td>FL^2[\alpha_4]</td>
<td>-0.0820*</td>
<td>-0.0328</td>
</tr>
<tr>
<td></td>
<td>(0.0430)</td>
<td>(0.0257)</td>
</tr>
<tr>
<td>Dummy: Consumption [\alpha_5]</td>
<td>-0.0738**</td>
<td>-0.0692***</td>
</tr>
<tr>
<td></td>
<td>(0.0344)</td>
<td>(0.0236)</td>
</tr>
<tr>
<td>Dummy: Household [\alpha_6]</td>
<td>-0.0332</td>
<td>0.0026</td>
</tr>
<tr>
<td></td>
<td>(0.0306)</td>
<td>(0.0321)</td>
</tr>
<tr>
<td>Dummy: Gross Income[\alpha_7]</td>
<td>0.2705***</td>
<td>0.0026</td>
</tr>
<tr>
<td></td>
<td>(0.0283)</td>
<td>(0.0158)</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>0.0024</td>
<td>0.0024</td>
</tr>
<tr>
<td></td>
<td>(0.0043)</td>
<td>(0.0041)</td>
</tr>
<tr>
<td>GDP per capita^2</td>
<td>-0.0000</td>
<td>-0.0000</td>
</tr>
<tr>
<td></td>
<td>(0.0000)</td>
<td>(0.0000)</td>
</tr>
<tr>
<td>Trade openness</td>
<td>-0.0356</td>
<td>-0.0356</td>
</tr>
<tr>
<td></td>
<td>(0.0688)</td>
<td>(0.0657)</td>
</tr>
<tr>
<td>Trade openness^2</td>
<td>-0.0039</td>
<td>-0.0039</td>
</tr>
<tr>
<td></td>
<td>(0.0142)</td>
<td>(0.0134)</td>
</tr>
<tr>
<td>Country and time dummies</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Constant [\alpha_0]</td>
<td>3.5172***</td>
<td>3.4010***</td>
</tr>
<tr>
<td></td>
<td>(0.0384)</td>
<td>(0.0094)</td>
</tr>
<tr>
<td>R^2</td>
<td>0.3430</td>
<td>0.8680</td>
</tr>
<tr>
<td>No. of observations</td>
<td>1,360</td>
<td>1,209</td>
</tr>
<tr>
<td>No. of countries</td>
<td>106</td>
<td>103</td>
</tr>
</tbody>
</table>

Robust standard errors clustered by country are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.
### Table 3: Impact of net foreign asset position openness on inequality

<table>
<thead>
<tr>
<th>Dependent variable: Inequality (in logs)</th>
<th>Pooled regression</th>
<th>Fixed effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFA [(a_1)]</td>
<td>-0.1359***</td>
<td>-0.0682</td>
</tr>
<tr>
<td></td>
<td>(0.0496)</td>
<td>(0.0521)</td>
</tr>
<tr>
<td>NFA(^2) [(a_2)]</td>
<td>-0.0379*</td>
<td>-0.0201</td>
</tr>
<tr>
<td></td>
<td>(0.0225)</td>
<td>(0.0220)</td>
</tr>
<tr>
<td>Dummy: Consumption [(a_3)]</td>
<td>-0.0598*</td>
<td>-0.0651**</td>
</tr>
<tr>
<td></td>
<td>(0.0302)</td>
<td>(0.0289)</td>
</tr>
<tr>
<td>Dummy: Household [(a_4)]</td>
<td>-0.0283</td>
<td>0.1007***</td>
</tr>
<tr>
<td></td>
<td>(0.0296)</td>
<td>(0.0293)</td>
</tr>
<tr>
<td>Dummy: Gross Income[(a_5)]</td>
<td>0.2831***</td>
<td>0.0010</td>
</tr>
<tr>
<td></td>
<td>(0.0280)</td>
<td>(0.0222)</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>0.0044</td>
<td>0.0044**</td>
</tr>
<tr>
<td></td>
<td>(0.0043)</td>
<td>(0.0022)</td>
</tr>
<tr>
<td>GDP per capita(^2)</td>
<td>-0.0001</td>
<td>-0.0001***</td>
</tr>
<tr>
<td></td>
<td>(0.0000)</td>
<td>(0.0000)</td>
</tr>
<tr>
<td>Trade openness</td>
<td>-0.0485</td>
<td>-0.0485</td>
</tr>
<tr>
<td></td>
<td>(0.0672)</td>
<td>(0.0434)</td>
</tr>
<tr>
<td>Trade openness(^2)</td>
<td>-0.0002</td>
<td>-0.0002</td>
</tr>
<tr>
<td></td>
<td>(0.0155)</td>
<td>(0.0125)</td>
</tr>
<tr>
<td>Country and time dummies</td>
<td>No Yes</td>
<td>No Yes</td>
</tr>
<tr>
<td>Constant [(a_6)]</td>
<td>3.5056***</td>
<td>3.4121***</td>
</tr>
<tr>
<td></td>
<td>(0.0273)</td>
<td>(0.0707)</td>
</tr>
<tr>
<td>R(^2)</td>
<td>0.3416</td>
<td>0.8558</td>
</tr>
<tr>
<td>No. of observations</td>
<td>1,383</td>
<td>1,230</td>
</tr>
<tr>
<td>No. of countries</td>
<td>106</td>
<td>103</td>
</tr>
</tbody>
</table>

Robust standard errors clustered by country are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.
Table 4: Impact of financial openness, financial assets and liabilities, and net foreign asset position on inequality. System GMM estimation.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Inequality (in logs)</th>
<th>Financial openness</th>
<th>Assets and liabilities</th>
<th>Net foreign asset position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lag of dependent variable</td>
<td>0.6043***</td>
<td>0.5942***</td>
<td>0.3664***</td>
<td></td>
</tr>
<tr>
<td>IFI</td>
<td>-0.0027</td>
<td>0.0056</td>
<td>(0.0731)</td>
<td></td>
</tr>
<tr>
<td>IFI²</td>
<td>-0.0004</td>
<td>-0.0010</td>
<td>(0.0011)</td>
<td></td>
</tr>
<tr>
<td>IFI³</td>
<td>-0.2357***</td>
<td>-1.659***</td>
<td>(0.0778)</td>
<td></td>
</tr>
<tr>
<td>IFI²</td>
<td>0.0485**</td>
<td>0.0590***</td>
<td>(0.0202)</td>
<td></td>
</tr>
<tr>
<td>FA</td>
<td>0.1835***</td>
<td>0.1571***</td>
<td>(0.0616)</td>
<td></td>
</tr>
<tr>
<td>FA²</td>
<td>-0.0392***</td>
<td>-0.0529***</td>
<td>(0.0174)</td>
<td></td>
</tr>
<tr>
<td>FA³</td>
<td>-0.2357***</td>
<td>-1.659***</td>
<td>(0.0778)</td>
<td></td>
</tr>
<tr>
<td>NFA</td>
<td>0.1571**</td>
<td>0.1835***</td>
<td>(0.0616)</td>
<td></td>
</tr>
<tr>
<td>NFA²</td>
<td>0.0485**</td>
<td>0.0590***</td>
<td>(0.0202)</td>
<td></td>
</tr>
<tr>
<td>Dummy: Consumption [a]</td>
<td>-0.0390</td>
<td>-0.0200</td>
<td>-0.0543*</td>
<td></td>
</tr>
<tr>
<td>Dummy: Household [b]</td>
<td>-0.0237</td>
<td>0.0090</td>
<td>-0.0205</td>
<td></td>
</tr>
<tr>
<td>Dummy: Gross Income[c]</td>
<td>0.2366***</td>
<td>0.1119***</td>
<td>0.2238***</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>5.441***</td>
<td>1.3874***</td>
<td>3.5490***</td>
<td></td>
</tr>
</tbody>
</table>

No. of observations: 1,383 865 1,383 865 1,230 810
No. of countries: 106 84 106 84 106 84

Robust standard errors clustered by country are in parenthesis.
*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.
Table 5: Impact of income volatility on inequality, for the whole period (1970-2015)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Income volatility</td>
<td>0.0573</td>
<td>0.0161</td>
<td>-0.0522</td>
</tr>
<tr>
<td></td>
<td>(0.0475)</td>
<td>(0.0424)</td>
<td>(0.0455)</td>
</tr>
<tr>
<td>Income volatility^2</td>
<td>-0.0052</td>
<td>-0.0020</td>
<td>0.0033</td>
</tr>
<tr>
<td></td>
<td>(0.0043)</td>
<td>(0.0037)</td>
<td>(0.0038)</td>
</tr>
<tr>
<td>GDP per capita</td>
<td></td>
<td></td>
<td>-0.0064***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.0016)</td>
</tr>
<tr>
<td>Dummy: Consumption</td>
<td>-0.0334</td>
<td>-0.1266**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0458)</td>
<td>(0.0505)</td>
<td></td>
</tr>
<tr>
<td>Dummy: Household</td>
<td>0.0735</td>
<td>0.2452***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0524)</td>
<td>(0.0582)</td>
<td></td>
</tr>
<tr>
<td>Dummy: Gross Income</td>
<td>0.2177***</td>
<td>0.1441***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0441)</td>
<td>(0.0475)</td>
<td></td>
</tr>
<tr>
<td>Constant [a_0]</td>
<td>3.5399***</td>
<td>3.5556***</td>
<td>3.8965***</td>
</tr>
<tr>
<td></td>
<td>(0.1154)</td>
<td>(0.1036)</td>
<td>(0.1372)</td>
</tr>
<tr>
<td>R^2</td>
<td>0.0134</td>
<td>0.2108</td>
<td>0.3338</td>
</tr>
<tr>
<td>No. of observations</td>
<td>106</td>
<td>106</td>
<td>106</td>
</tr>
</tbody>
</table>

Robust standard errors clustered by country are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Table 6: Average income volatility, per period

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>1990-1994</td>
<td>3.36</td>
<td>2.75</td>
<td>2.44</td>
<td>2.20</td>
<td>2.84</td>
</tr>
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</table>
Table 7: Impact of income volatility on inequality, per period.

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Income volatility</td>
<td>0.1362***</td>
<td>0.0985***</td>
</tr>
<tr>
<td></td>
<td>(0.0395)</td>
<td>(0.0362)</td>
</tr>
<tr>
<td>Income volatility$^2$</td>
<td>-0.0103***</td>
<td>-0.0075**</td>
</tr>
<tr>
<td></td>
<td>(0.0035)</td>
<td>(0.0031)</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>-0.0599**</td>
<td>-0.0745***</td>
</tr>
<tr>
<td></td>
<td>(0.0266)</td>
<td>(0.0235)</td>
</tr>
<tr>
<td>Dummy: Consumption</td>
<td>-0.0606</td>
<td>-0.1659**</td>
</tr>
<tr>
<td></td>
<td>(0.0489)</td>
<td>(0.0766)</td>
</tr>
<tr>
<td>Dummy: Household</td>
<td>-0.0231</td>
<td>0.0442</td>
</tr>
<tr>
<td></td>
<td>(0.1008)</td>
<td>(0.1213)</td>
</tr>
<tr>
<td>Dummy: Gross Income</td>
<td>0.2116***</td>
<td>0.1642***</td>
</tr>
<tr>
<td></td>
<td>(0.0478)</td>
<td>(0.0507)</td>
</tr>
<tr>
<td>Constant $</td>
<td>a_0$</td>
<td>3.3427***</td>
</tr>
<tr>
<td></td>
<td>(0.0952)</td>
<td>(0.0842)</td>
</tr>
</tbody>
</table>

<table>
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<td>(0.0842)</td>
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</tbody>
</table>

R$^2$ values are 0.1111 for 1970-2007, 0.2529 for 2008-2015, 0.3069 for 2008-2015, 0.0351 for 2008-2015, 0.1951 for 2008-2015, 0.2690 for 2008-2015.

No. of observations: 105, 104, 104, 93, 88, 88.

Robust standard errors clustered by country are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.