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Inequality Implications of EMU Membership: A Reassessment

Philip Arestis, University of Cambridge, UK

Peter Phelps, University of Leeds, UK

Abstract:

A growing number of studies have concluded that the European Economic and Monetary Union (EMU) has exacerbated inequalities in income, wealth and society. Furthermore, the endogeneity of income inequality is now becoming recognised as an important part of the cost-benefit analysis of euro currency adoption. Yet the nature, significance and scale of different monetary (and market) integration channels in operation in EMU remain uncertain. In this contribution we employ static and dynamic panel data methodologies to investigate the intra-national household inequality implications, both realised and expected over coming years. Our analysis reveals that the within-country inequality outcomes differ significantly for core and non-core country-groups in EMU, which have so far realised very different distributional costs and benefits from the integration process. These are crucial issues for policy-makers, not just for EMU member states, but for other countries as well, especially the European Union (EU) countries that are expected to adopt the euro currency in the future. This is so in terms of their attempts to look for, design and implement policies, which alleviate within-country inequality.

Keywords: European; monetary integration; income inequality; panel data

JEL Classifications: E63; F15; F4

1. Introduction

A growing number of studies have concluded that the process of European economic and monetary integration has exacerbated inequalities in income, wealth and society (see, for example, Bouvet, 2010; Bertola, 2016; Agnello et al., 2016). Moreover, the inequality implications seem important in relation to the Optimal Currency Area (OCA) theory, which asserts that candidate countries should consider carefully the costs and benefits of adopting a common currency (see Mundell, 1961). An important characteristic of this debate is the endogeneity of the cost-benefit analysis because monetary integration may bring about an increase in market integration, which can affect the level, growth rate and convergence of international incomes (see, for example, Frankel and Rose, 1998, and 2002; see also Eurofound, 2017). Yet despite considerable expansions in market integration experienced over recent decades, the within-country inequality implications of economic and monetary union remain uncertain, both in theory and practice, including for those countries and households which look ahead to EMU's prospective enlargement.[1] Against this backdrop, this paper's primary contribution is to provide a reassessment of EMU's inequality implications, both realised and expected over the coming years. In doing so, we focus on one prominent indicator – the within-country distribution of household income.

In the EU, and prior to the late 1970s, inequality declined in view of the expansion of the welfare state and social provision, along with progressive income taxation. However, since

the 1980s the EU has failed to reduce inequality as a result of explicit policy decisions aimed at cutting back on benefits. However, prior to 2008 inequality declined due to economic integration and income convergence amongst countries, which had been accelerated by the creation of the euro currency (Eurofound, 2017). This is very much in line with the European Commission's viewpoint that monetary integration would increase income convergence across countries. However, the international convergence story masks considerable heterogeneity, because inequality has increased at a faster rate within member states than it has across them. In Germany, for example, and according to the OECD (2008), income inequality among households grew faster than in any other OECD country over the years 2000 to 2005; whereas within-country inequality actually fell in many other EU countries, up to a point (see also Bertola, 2016).[2] The rising inequality in core (mainly northern) European countries following the creation of the European Central Bank (ECB) in 1998 contrasts sharply with the falling inequality experienced outside of the core (mainly in southern) European countries up until the onset of the Global Financial Crisis (GFC) in 2008, resembling a European inequality puzzle. After 2008 total income inequality grew in view of the emergence of the GFC and the ensuing sovereign debt crisis; also because income inequality within certain European countries increased (the period the Eurofound, 2017, examines is 2005-2014; with the income variable referring to 2004-2013). The main causes of the experience examined are thought to be unemployment, labour market reform and changes in the capacity of households and welfare states to cushion income effects.

The impact of European integration on household income inequality is multidimensional and may be analysed from different theoretical perspectives. For example, a more unified monetary space encourages technological diffusion among countries, which tends to increase wage disparities within countries due to skill-biased change, especially in countries which most closely resemble a neoclassical world (Bound and Johnson, 1992). Also, inequality may evolve ambiguously and according to relative factor abundance, both in the home country and abroad. For example, the Stolper-Samuelson theorem predicts higher inequality in more integrated economies where capital is relatively abundant; whereas inequality implications may be very different in economies where labour is relatively abundant (Stolper and Samuelson, 1941). From a financial liberalisation perspective, financial integration may exacerbate inequality in countries with underdeveloped institutions; or if it biases financial access in favour of the most affluent households and individuals (Furceri and Loungani, 2015). Heterodox theories do not dispute the imperfections acknowledged within orthodox and more contemporary integration theories (see for example, Feenstra and Hanson, 1996, versus Grossman and Rossi-Hansberg, 2008). But alternative perspectives emphasise instead the evolving power relations and changes in political and institutional environments, which benefit some households at the expense of others (see, for example, Rodrik, 1997; Epstein, 2005; Matthijs, 2016).

The literature reveals a rather mixed and uncertain picture of inequality, theoretically and empirically. A major strand of the empirical literature examines spatial inequalities using national or regional income; however, these studies pay particular attention to disparities in income across countries and regions, as opposed to the disparities among households within individual countries (see, for example, Ezcurra and Pascual, 2008; Bouvet, 2010; Agnello et al., 2016).[3] Most studies that deal with within-country income inequality among households adopt a more descriptive approach (see Eurofound, 2017, and the literature surveyed therein). Studies highlight particularly the trends emerging in the EMU and in the EU following enlargement; but they do not purport to identify the underlying integration channels. The existing econometrics-based literature is limited in other ways too, with its emphasis on

national economic development, which was considered the primary driver of household income inequality (Williamson, 1965). However, international market integration forces associated with monetary union, in the form of economic, financial and technical integration, may also significantly affect primary and functional income inequality in a more integrated and globalised world (see, for example, Bertola, 2010; see also Stockhammer, 2017).[4] Empirical work has been hindered in part due to lack of high quality, standardised data on household income inequality; while EMU is a relatively recent and evolving currency area in terms of its creation and enlargement. Yet its within-country inequality implications are highly relevant to academics, policy-makers and politicians. Further empirical work is now an essential next step to establish whether and how monetary and market integration have impacted on the within-country inequality in European countries; and how inequality might evolve in the future.

This paper contributes to the literature as follows. First, by maximising comparability for the largest possible sample, the Standardised World Income Inequality Database (SWIID) facilitates a more comprehensive analysis of the drivers of within-country inequality among European households than other available sources with more observations across time and space; while it includes a number of recent euro adoptees and countries that are expected to join EMU in the future. Second, this paper employs an empirical strategy, which permits identification and inference of monetary and market integration channels related to economic, financial and technical integration. To this end, three different, but related panel data estimators are employed: pooled ordinary least squares (POLS), least squares dummy variables (LSDV), and generalised method of moments (GMM-IV). These methodologies have previously been employed in the empirical literature; but this paper provides some further usage. In particular, static and dynamic panel data techniques have not been utilised previously to infer the sign, size and significance of monetary and market integration effects arising across European country-groups. Third, our dynamic approach helps build-up a clearer picture of the within-country inequality implications emerging, both realised and expected over the coming years. This latter contribution is useful given the temporal persistence of household income inequality, while it permits further inference about the short- and long-run inequality implications for prospective EMU member states.

This paper's empirical strategy is relatively robust and involves estimation of both static and dynamic panel data models. The sample comprises 34 countries and we utilise the Gini index from SWIID, using data from 1970 up to 2015; however, some comparison of results is provided using alternative inequality/polarisation measures. The sample includes key phases of monetary transition and includes several subsequent EU and EMU enlargement rounds. Our empirical strategy helps uncover new and interesting results, which differ from what had been acknowledged previously. Though monetary and market integration effects have reduced income inequality in the average EMU household, the inequality implications are significantly less favourable for the EMU core countries vis-à-vis non-core countries. Furthermore, and contrary to some indications in the literature, the current group of EMU candidate countries could over time benefit from economic and monetary union by much more than had previously been acknowledged; however, the distributional benefits to prospective member states may coincide with significant costs to the current incumbents. These are crucial issues for policy-makers, in terms of their attempts to look for, design and implement policies, which alleviate rather than exacerbate within-country inequality.

The paper is structured as follows. Section 2 provides a brief overview of key theoretical channels. Section 3 sets out the empirical methodology. Section 4 discusses sample selection

and related measurement issues. Section 5 describes key data and provides summary statistics. Section 6 presents the empirical analysis. Section 7 summarizes and concludes.

2. Theoretical Overview

The channels through which European economic and monetary union are thought to affect within-country household income inequality are varied and theoretically ambiguous. However, there are at least three prominent market integration channels, which are relevant to the endogeneity debate since member states can expect to become more integrated in a monetary union in terms of trade, finance and technology. There are also other monetary integration effects on inequality, which exist net of market integration effects; this includes evolution of institutional and policy environments, which may affect within-country inequality in different ways, including deregulation and labour market reform. Furthermore, particular macroeconomic and social policies extend from international agreements for EU membership – a precursor to EMU – that can affect inequality through changes in social provision. In what follows below, the main monetary and market integration channels are briefly discussed with respect to prominent theories.

2.1 Monetary Integration

Monetary integration is thought to affect within-country inequality among household in different ways, although there is no consensus as to the most important mechanism. For one, the increased price transparency in a single currency area increases the appeal of policies that encourage efficiency, deregulation and wage restraint. For one, Bertola (2016) shows that monetary union creates incentives for labour market reform in capital-rich countries, which tends to increase inequality in the EMU core and reduce it elsewhere. From a race-to-the-bottom perspective, the differing inequality implications are entirely consistent with models of policy competition among countries with different capital intensities and sizes. From a monetary policy credibility perspective, the ability of the ECB to anchor inflationary expectations and foster wage restraint is often cited favourably (see Kydland and Prescott, 1977; see also Issing, 2003). However, this can increase inequality in formerly low monetary policy credibility countries, which are mainly located outside of the core, assuming increased credibility does not reduce incentives for deregulation in these countries (Calmfors, 2001). From a political economy perspective, EMU's institutional and political environment encourages deflationary adjustment and austerity in the oldest member states; whereas under the fixed exchange rate regime newer member states benefit from debt-driven consumption, investment and wage growth, at least in normal times (Matthijs, 2016). Therefore, monetary integration can affect inequality very differently across and within member states.

2.2 Technical Integration

From a traditional (neoclassical) perspective, technology plays a crucial role in driving productivity and earnings. Over more recent decades neoclassical economists have upgraded the conventional model of technological progress to explain the widespread increase in inequality. In particular, the skill-biased technical change hypothesis asserts that technological innovations generate a wage premium among workers in high-tech sectors, such as information and communications technology, which increases income inequality (see, for example, Bound and Johnson, 1992; see also Card and DiNardo, 2002). The revised neoclassical theory essentially predicts that countries with stronger informational linkages are more likely to experience skill-biased change; therefore, income inequality may be higher among households in more technically integrated countries. To the extent that international

trade in information and communications technology are more closely related to a country's propensity to import technical change, integration in high-tech sectors may be a more important determinant of inequality than trade in other goods/services and financial integration (see OECD, 2007; see also Jaumotte et al., 2013).

2.3 Trade Integration

Trade integration is among the most prominent factors thought to affect the within-country distribution of household income.[5] Classical international trade theory has developed from the Heckscher-Ohlin (HO) model. Most prominently, and according to the Stolper-Samuelson theorem, trade encourages specialisation in production according to relative factor abundance (Stolper and Samuelson, 1941). In effect, the wages of skilled workers increase relative to unskilled workers in the most advanced economies; whereas the wages of unskilled workers increase relative to skilled workers in countries where exports are predominantly derived from unskilled labour. More contemporary trade theories begin from an assumption of imperfect competition and incorporate off-shoring, which can increase household income inequality more generally if the relocated low-skilled production is viewed as high-skilled outside of the home country (Feenstra and Hanson, 1996). Alternatively, low-skilled production may be shared among trading countries in a way that increases productivity and reduces inequality in both types of countries (Grossman and Rossi-Hansberg, 2008). Heterodox theories do not dispute the imperfections acknowledged in contemporary trade theories; but they emphasise instead the impact of integration on institutional structures and bargaining relationships. For example, according to the political economy of globalisation perspective, integration and globalisation give firms more power to reduce domestic wages or substitute foreign workers for domestic workers (Rodrik, 1997). Therefore, further economic integration can influence the path of inequality ex post, and not just in the home country.

2.4 Financial Integration

The traditional financial liberalisation thesis, which prevails among neoclassical economists, asserts that financial integration can enhance the efficient allocation of capital, which accelerates aggregate growth and contributes to reducing inequality (Beck et al., 2007). But, financial integration may exacerbate inequality among households in countries with relatively underdeveloped institutions and financial systems; or if it biases financial access in favour of the most affluent households and individuals (Furceri and Loungani, 2015). The financialisation perspective among heterodox economists is more in line with the latter outcome. Essentially capital may mobilise in a more financially integrated and financialised world in a way that benefits capital rather than labour due to a redistribution of rents rather than as a result of market imperfections (see Epstein, 2005; see also Stockhammer, 2017). Financial liberalisation and financialisation have also been linked to macroeconomic and financial instability, which tends to more than proportionately affect the poorest in society (see Arestis and Sawyer, 2005, and the literature therein); and advantage the richest, especially the financial sector (Arestis, 2016) .

2.5 Policies for Redistribution, Employability and Cohesion

Alternative adjustment and transfer mechanisms are viewed as crucially important in an OCA context where asymmetric shocks can contribute to higher inequality. This is especially so in the policy environment of the EMU, wherein countries are constrained in their use of national fiscal policies to smooth out shocks across the business cycle. Furthermore, international agreements, such as the EU Stability and Growth Pact, encourage fiscal discipline as a pre-

requisite for euro currency adoption. This has resulted in fiscal consolidation and reduced social provision, to the extent that countries now have less control over the distribution of income using national fiscal policies, not more. At the same time, there are international policies designed to promote employability and social cohesion, which might play a part in alleviating household income inequality. Notably, the European Social Fund (ESF) is the EU's main vehicle to redistribute international funds for supporting employment and social inclusion within individual countries; however, it remains unclear whether it has helped offset inequality-inducing policies and agreements related to the Maastricht Criteria (see Agnello et al., 2016).

3. Empirical Methodology

This paper's econometric methodology is not formally derived from a specific theoretical foundation; but instead it draws on a pluralistic approach and incorporates key ingredients of prominent theories as discussed in the previous section. Our modelling approach may also be related to the approaches of Bertola (2010), Bouvet (2010) and Agnello et al. (2016). But there are differences between these contributions and ours. Bertola (op. cit.) and Bouvet (op. cit.) utilise dummy variables within pooled and panel OLS frameworks to estimate the EMU membership effect following the euro's electronic introduction. However, these studies do not fully account for the impact of observed (and unobserved) heterogeneity on inequality, including the impact of trade, financial and technical integration, which may be influenced by the process of monetary integration itself. Also these studies employ static model specifications, which are useful to an extent; but static models provide limited insight into the dynamic monetary and market integration effects across and within European countries. Alternatively, Agnello et al. (op. cit.) control for endogeneity using an instrumental variables (IV) approach and employ instead a dynamic fixed effects panel data model, but do not focus on the inequality implications of economic and monetary union. For comparison and robustness we utilise both static and dynamic panel data approaches.

3.1 Static Models

The static panel data model specification, as set out in equation (1), links a within-country household income inequality index ($Gini_{i,t}$) in country i in period t, to a set of monetary integration variables ($EMU_{i,t}$) related to transition and union; market integration variables ($Market_{i,t}$) related to economic, financial and technical integration; additional control variables ($Z_{i,t}$); and a collection of fixed effects (η_i and θ_t):

$$\mathrm{Gini}_{i,t} = \alpha + \beta' \mathrm{EMU}_{i,t} + \gamma' \mathrm{Market}_{i,t} + \lambda' \mathrm{Z}_{i,t} + \mathrm{v}_{i,t} \quad (1)$$

$$\mathrm{Gini}_{i,t} = \alpha + \sum\nolimits_{G} \beta'_{G} \varphi_{G} \mathrm{EMU}_{i,t} + \sum\nolimits_{G} \gamma'_{G} \varphi_{G} \mathrm{Market}_{i,t} + \sum\nolimits_{G} \omega_{G} \varphi_{G} + \lambda' \mathrm{Z}_{i,t} + \mathrm{v}_{i,t} \quad (2)$$

where $\mathrm{v}_{i,t} = \eta_i + \theta_t + \varepsilon_{i,t}$

Coefficient vector β corresponds to monetary integration variables; coefficient vector γ corresponds to market integration variables; coefficient vector λ corresponds to a set of additional control variables. Unobserved heterogeneity in the cross-sectional and time-series dimensions is controlled for through collections of country (η_i) and time (θ_t) fixed effects. Residual variation is captured by the error term, $\varepsilon_{i,t}$. Moreover, because monetary and market integration may affect inequality differently across country-groups, extension of the first

model permits a comparative analysis at a country-group level. To that end, equation (2) includes also a binary indicator variable, φ_G, which facilitates country-group level analysis using dummy variable interaction terms. The interaction variables are constructed by multiplying market integration variables by the group indicator variable. The term $\Sigma_G\omega_G\varphi_G$ is a collection of country-group fixed effects. Inclusion of the various country-group interaction terms in a single equation enables both comparison and inference of whether the relevant slope coefficients differ from each other and from zero. Specifically, β_G and γ_G correspond to monetary and market integration slopes for country-group G, respectively.[6]

3.2 Dynamic Models

To identify short- and long-run inequality implications arising from European monetary and market integration, while accounting for the temporal persistence of within-country inequality, we specify two dynamic models. Equations (3) and (4) correspond to the dynamic setup, whereby a one period lag of the Gini index is included as an additional explanatory variable:

$$\mathrm{Gini}_{i,t} = \alpha + \rho\mathrm{Gini}_{i,t-1} + \beta'\,\mathrm{EMU}_{i,t} + \gamma'\,\mathrm{Market}_{i,t} + \lambda'\,\mathrm{Z}_{i,t} + \mathrm{v}_{i,t} \tag{3}$$

$$\mathrm{Gini}_{i,t} = \alpha + \rho\mathrm{Gini}_{i,t-1} + \sum\nolimits_{G} \beta'_{G}\,\varphi_{G}\,\mathrm{EMU}_{i,t} + \sum\nolimits_{G} \gamma'_{G}\,\varphi_{G}\,\mathrm{Market}_{i,t} + \sum\nolimits_{G} \omega_{G}\varphi_{G} + \lambda'\,\mathrm{Z}_{i,t} + \mathrm{v}_{i,t} \tag{4}$$

where $\mathrm{v}_{i,t} = \eta_i + \theta_t + \varepsilon_{i,t}$

Under the static specifications of equations (1) and (2), which exclude the lagged dependent variable as an additional regressor, the independent variables represent the full set of information corresponding to the observed level of inequality. However, under the dynamic specification, the entire history of the regressors is incorporated within the model. Therefore, income inequality evolves according to a pre-determined path, enabling distinction between short- and long-run inequality implications arising from changes in explanatory variables. In equations (3) and (4) the size and significance of the estimated persistence parameter, ρ, provide an indication of inequality's path-dependence. Essentially, the greater the persistence, the more inequality is explained in the short-run by its preceding level relative to variation in other explanatory variables.

3.3 Endogeneity

At this stage it is useful to briefly revisit the endogeneity problem, which complicates the task of identifying the determinants of household income inequality. First, there may be important omitted influences relating to economic structure or the quality of institutions, in addition to common global shocks, which correlate with both income inequality and the included explanatory variables. For example, countries with minimum-wage legislation may also have more generous policies for social provision, while both factors may contribute to reducing income inequality. Omission of either minimum wage or social provision variables tends to bias the estimate of the included variable under a pooled estimation framework. Second, measurement error may affect the key variables and could in principle generate endogeneity bias; for example, exchange rate regime and financial integration may be measured in different ways. Third, it is possible that income inequality also affects the set of explanatory variables via its impact on economic policy, such as through social protection. Countries with

higher household income inequality may also benefit from more generous policies for social protection, which aim to alleviate inequality.

This paper's attempt to address endogeneity concerns is threefold. First, to account for omitted-variables bias arising from unobserved spatial and dynamic heterogeneity; country and time fixed effects are included to capture hard-to-measure influences in operation nationally and internationally. Second, to the extent that outliers may reflect omitted variables and measurement errors, we follow Huber (1964) among others by utilising iteratively re-weighted robust least squares (IRLS), which helps to address extreme (outlier) observations by assigning higher weights to better behaved observations. In the current context this also helps to address parameter instability related to the GFC. Third, fixed effects IV estimators are utilised to estimate equations (1)-(4). For equations (1)-(2), which correspond to the static model specifications, the two-stage generalised method of moments (GMM-2S) estimator of Hansen (1982) is employed, which solves an objective function based on underlying moment conditions. Its main advantage over the two-stage least squares (2SLS) technique, is efficiency in the presence of heteroscedasticity and autocorrelation. Finally, the one-step first-difference (GMM-FD) estimator of Arellano and Bond (1991) and the two-step system (GMM-SYS) estimator of Arellano and Bover (1995) are considered for equations (3)-(4), since fixed effects estimators may yield biased and inconsistent estimates in a dynamic context.

4. Sample Selection and Measurement

The sample reflects the current and prospective membership of EMU: EMU core countries include Austria, Belgium, Finland, France, Germany, Luxembourg and the Netherlands. EMU non-core countries include Cyprus, Greece, Ireland, Italy, Portugal and Spain (the periphery countries) as well as Slovakia, Slovenia, Estonia, Latvia and Lithuania, which have adopted the euro currency over more recent years. EMU candidate countries are Bulgaria, Croatia, Czech Republic, Hungary, Poland and Romania. The following group of advanced economy (non-EMU) countries is also included: Australia, Canada, Denmark, Japan, New Zealand, Norway, Sweden, Switzerland, United Kingdom and United States. Most data are available at annual frequency from the early 1970s until 2013 for the 34 countries. The baseline sample covers the period 1970-2013; however, for robustness some comparison is provided using different samples and newly released data up to 2015. Moreover, because including additional explanatory variables usually implies a trade-off between model control and sample size, we have endeavoured to use the best variables available, while keeping the sample size as large as possible. This reflects also pre-testing and a preference for variables that have proven robust in other studies.[7]

4.1 Income Inequality

The inequality index ($Gini_{i,t}$), is defined for country i in year t according to the SWIID.[8] In terms of construction of the SWIID, household income inequality data from the Luxembourg Income Study (LIS) are first added to the World Income Inequality Database (WIID). Inequality is computed net of government taxation and transfers. The combined dataset is then standardised via a custom missing-data statistical algorithm (Solt, 2016). An advantage of the SWIID compared to alternatives is that it accounts for the concept, definition of income and recipient unit (Agnello and Sousa, 2014). Additionally, the SWIID employs a transparent procedure to increase comparability of national inequality data across countries – an important consideration given the international focus of our study. Data are initially scaled

from 0-100 (where 0 indicates perfect equality and 100 indicates perfect inequality), before being transformed using the natural-logarithm function.

4.2 Monetary Integration

A set of dummy variables helps capture changes in inequality associated with different phases of monetary integration. Primarily, we employ the dummy variable $EMU_{i,t}^{OVERALL}$, which takes a value of unity from 1999 (or from the year of euro currency adoption for subsequent adoptees) until the end of the sample period; and zero otherwise. Three other dummy variables are employed. First, the dummy variable $FIX_{i,t}$ takes a value of unity if a country has a fixed exchange rate according to the classification of Ilzetzki et al. (2017); and zero otherwise.[9] This accounts for various official and unofficial exchange rate regimes, including the Exchange Rate Mechanism (ERM II), which is a pre-requisite exchange rate regime that involves pegging of national currencies to the benchmark or common currency for a minimum of two years before euro currency adoption. Second, the dummy variable $EMU_{i,t}^{ELECTRONIC}$ takes a value of unity for the years 1999-2001, which corresponds to the euro's electronic introduction; and zero otherwise. Third, the dummy variable $EMU_{i,t}^{PHYSICAL}$ takes a value of unity from 2002 (or from the year of euro adoption for subsequent adoptees) until the end of the sample, and corresponds to the euro's physical introduction; this variable takes a value of zero in all other periods. It is intended that consideration of the different measures will help build-up a more complete picture of the transition to monetary union.

4.3 Market Integration

This paper considers market integration in the form of technical, trade and financial integration. Technical integration ($Technology_{i,t}$) is defined as the total exports in high-tech products, normalised by country i's nominal GDP in year t. Trade integration ($Trade_{i,t}$) is defined as the sum of exports and imports, normalised by country i's nominal GDP in year t. Data are sourced from World Bank's World Development Indicators (WDI) database.[10] Financial integration ($Finance_{i,t}$) is measured using Chinn and Ito's (2006) capital account openness index, which is constructed from binary dummy variables that codify the tabulation of restrictions on cross-border financial transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions. Data are sourced from Chinn and Ito's (op. cit.) updated database. All market integration variables are transformed by the natural logarithm.

4.4 Social Protection

The proportion in GDP spent on public social expenditure (excluding old-age and survivors benefits) ($SPI_{i,t}$) is included to control for social policy's effect on inequality. Data are sourced from Eurostat for European countries and from the OECD database for all other countries. Another dummy variable ($ESF_{i,t}$) is included to capture whether countries have access to the ESF, which is the EU's oldest and main vehicle for redistributing finance to promote employment and social inclusion. This fund has evolved since 1957 to support development of the least prosperous countries and regions, including those suffering from industrial decline, and aims to reduce long-term unemployment, while enhancing employability for young people. Access is determined according to annual activity reports and ex-post evaluation documentation from the Archive of European Integration until 1989 and for subsequent years from the European Commission.[11]

4.5 GDP-per-capita

GDP-per-capita ($GDPCAP_{i,t}$) is defined as the income-per-inhabitant.[12] As higher per-capita incomes are associated with more progressive taxation policies and stronger welfare systems, the square of GDP-per-capita ($GDPCAP^2_{i,t}$) is included to account for the possibility of a non-linear relationship with inequality (Agnello and Sousa, 2014, p. 710). Data are sourced from the WDI database and are transformed by the natural logarithm.

4.6 Urbanisation

The share of the population living in urban areas ($Urbanisation_{i,t}$) is included to capture agglomeration and developmental effects on inequality arising through the process of urbanisation (Venables, 2005). Data are scaled in percentage points and sourced from the WDI database.

4.7 Other Controls

Dummy variables are included to capture inequality effects arising from EU and World Trade Organisation (WTO) memberships ($EU_{i,t}$ and $WTO_{i,t}$, respectively). Another dummy variable, $Crisis_{i,t}$, which takes a value of unity during the period 2008-2011 and zero otherwise, is added to control for the GFC.

5. Data Description and Summary Statistics

Table 1 provides a statistical summary of the level of the Gini index for the full sample, for EMU and non-EMU member states, and for various country-groups, which are defined under Table 1.

Table 1. Gini Index Summary Statistics

	N	Mean	SD Country	SD Year	SD Panel	AR(1)	Minimum	Maximum
All	1373	27.942	2.667	4.322	4.533	0.894***	15.677	40.366
Non-EMU	669	27.379	2.693	4.011	4.417	0.877***	17.478	37.816
EMU-All	704	28.486	2.644	4.451	4.579	0.894***	15.677	40.366
EMU-Core	308	26.237	1.553	2.384	2.601	0.852***	19.644	40.366
EMU-Non-Core	396	30.194	4.126	2.743	5.083	0.905***	15.677	38.519
EMU-Periphery	248	31.899	2.488	3.471	3.516	0.918***	19.988	38.429
EMU-Candidates	229	26.132	3.339	2.991	4.270	0.848***	17.478	36.086

Source: Authors' own calculations.
Notes: SD stands for standard deviation. AR(1) is the first-order autocorrelation coefficient. Significance is indicated by: * (10%), ** (5%), ***.

Table 1 indicates that household income inequality is comparable across all EMU and non-EMU countries. However, inequality is highest, most persistent, and variable in the EMU non-core and periphery country-groups. This reflects in part the considerable volatility experienced by periphery countries, especially since the onset of the GFC. Interestingly the level of inequality in the current EMU candidate country-group is lower than in the periphery country-group, and is more similar to the EMU core country-group. However, the temporal variation in the EMU candidate country-group is more comparable to the EMU non-core country-group, which may reflect the substantial transition and integration of Central and Eastern European countries and several former Soviet states into the European marketplace.

6. Empirical Analysis

6.1 Aggregated Estimation Results

Table 2 provides an indication of household income inequality determinants across all countries and years in the sample. Various estimators are considered for comparison and robustness, including POLS and LSDV, as well as static and dynamic GMM-IV estimation.[13] The estimation output reveals significant monetary and market integration effects on within-country income inequality, which attain a higher level of statistical significance after inclusion of fixed effects.

Under the static approach European monetary integration has reduced the Gini index by about 3% from 1999 until 2013; while estimates for β_2 and β_3 indicate that inequality has fallen further following the euro's electronic introduction in 1999. On this evidence the fixing of exchange rates and introduction of the euro currency have contributed to reducing inequality among households, which contrasts sharply with Bertola's (2010) finding that EMU has increased inequality. Even after controlling for national social expenditure, among other influences as we do in Table 2, the monetary integration effect remains favourable and significant net of trade, financial and technical integration. Monetary union appears to have strengthened the European marketplace, which supports the viewpoint that monetary union has created employment and earnings opportunities, especially outside of the EMU core countries (see, for example, Matthijs, 2016). Though Bertola's (2016) argument that monetary union increases inequality via deregulation and labour market reform in the core countries does not seem supported by our aggregated results; we also include Slovakia, Slovenia, Estonia, Latvia and Lithuania in the sample; therefore the EMU effect in Table 2 may be less attributable to core countries and more attributable to newer member states.

This paper's findings go above and beyond previous studies in other ways too. A doubling of trade openness significantly reduces the Gini index by approximately 6%-9%. A conventional interpretation is that international trade has reduced inequality in countries with an abundance of low-skilled workers (Stolper and Samuelson, 1941). This outcome is also consistent with newer theories related to the production-sharing hypothesis, whereby low-skilled production is shared among trading countries in a complementary way that generally increases productivity (and wages) and reduces inequality at home and abroad, rather than the off-shoring hypothesis (see Grossman and Rossi-Hansberg, 2008, versus Feenstra and Hanson, 1996). Table 2 provides some evidence that financial integration significantly increases inequality, perhaps due to market imperfections and underdevelopment; or if financial liberalisation biases financial access in favour of the most affluent households and individuals (Furceri and Loungani, 2015). Financial liberalisation and financialisation give power to capital and finance relative to labour and encourage instability, which can impact disproportionately on the poorest in society (Arestis and Sawyer, 2005; Epstein, 2005; Arestis, 2016). By comparison, the technical integration channel is relatively weak and insignificant, even though the positive estimates are not unexpected according to the skill-biased change hypothesis (Bound and Johnson, 1992).

National social protection expenditure is highly significant and negatively associated with intra-national income inequality, which accords with expectations and evidence elsewhere (see Bertola, Table 5, p. 361). Bertola's (op. cit.) estimation implies that EMU membership increases the Gini index by up to 2 points via reduced national social protection expenditure; however, the outcome is closer to zero in Table 2 despite always being significant at the 1% level. Additionally, Table 2 reveals that countries with access to the ESF have experienced a

reduction in inequality by 1-3%, or up to 1 point on the sample mean of the Gini index. Our results indicate that the ESF has, by facilitating projects for employment and social inclusion, at least partially offset the reduction in social protection spending arising at a national level, which adds more favourable evidence to the current debate (see, for example, Dall'Erba and Fang, 2017).

After accounting for spatial and dynamic heterogeneity EU membership increases the Gini index by approximately 5%. A possible explanation is that the EU dummy variable captures political integration effects, which exist separately from globalisation and European economic integration effects. This adds further weight to the argument that other, less favourable channels are operational, with the EU Stability and Growth Pact and associated fiscal consolidation as a prominent candidate (see Agnello and Sousa, 2014; see also Agnello et al., 2016). Interestingly, the WTO membership effect becomes positive under GMM-FD estimation, which provides some evidence for the political economy of globalisation perspective that globalisation has increased inequality because it weakens the bargaining power of workers (Rodrik, 1997).

Table 2 also reveals that GDP-per-capita is, after a certain point, associated with lower inequality. The model-implied critical point can be determined from the solution to the following equation: $\partial Gini_{i,t}/\partial GDPCAP_{i,t} = \lambda_1 + 2\lambda_2 \log(GDPCAP_{i,t}) = 0$, where λ_1 and λ_2 are the first two elements in the aforementioned coefficient vector for the control variables, λ. The result in column (8) implies that income inequality increases up to $\log(GDPCAP_{i,t}) \approx 10$, after which inequality declines. Therefore, higher GDP-per-capita corresponds to lower inequality among households, which is not unexpected as more developed countries tend to have stronger redistributional systems, which corroborates the findings elsewhere (Agnello and Sousa, 2014).

Pooled and fixed effects estimates sometimes differ qualitatively and quantitatively; therefore, some caution is required. First, fixed effects are highly significant. This is suggestive of important unobservable factors, which, if unaccounted for (under POLS), may be correlated with the dependent variable and included regressors, generating omitted-variables bias (see also Table 3, for further evidence in a cross-sectional context). Second, Granger-causality tests provide some evidence of reverse causation between inequality and particular explanatory variables, although the causal ordering tends to run from the explanatory variable set to inequality rather than vice versa.[14] Third, Hausman's (1978) test is rejected, which suggests that the endogeneity bias is sufficiently severe, such that POLS and fixed effects estimators yield quantitatively different point estimates.[15] Therefore, fixed effects estimation is preferred going forward, particularly GMM-IV estimation, which provides a more general solution to the endogeneity problem. However, there is also a similarity between results obtained using different estimators in what follows.

6.2 Static Versus Dynamic Estimation

In order to provide some comparison of static versus dynamic estimation, we utilise Arellano and Bond's (1991) dynamic GMM-FD estimator, which is preferred over Arellano and Bover's (1995) GMM-SYS estimator as the underlying identification assumptions for the latter are rejected. See columns (7)-(10) of Table 2.[16] These estimates reveal significant path-dependence in income inequality, which is influenced to a greater extent in the short-run by its previous level and to a lesser extent by changes in the explanatory variables. However, the estimate for ρ of about 0.6 implies that the long-run EMU membership effects are around $(1-0.6)^{-1} = 2.5$ times as large as the short-run effects – see columns (7)-(8) versus columns (9)-

(10). Therefore, monetary integration reduces the Gini index directly and immediately by 3%, as indicated in column (7); and by around 7% in the long-run according to column (9). See also the cumulative impulse response-path of the Gini index following a monetary integration shock in Figure A1 (as in the Appendix). Therefore, reliance on the (static) model appears to understate the impact of monetary integration on inequality, which has evolved across the sample.

Table 2. Aggregated Estimation Output

	Static Estimation						Dynamic Estimation			
	POLS		LSDV		GMM-2S		GMM-FD (Short-Run)		GMM-FD (Long-Run)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
L.Gini	-	-	-	-	-	-	0.558***	0.587***	-	-
							(0.020)	(0.019)		
FIX	-	-0.091***	-	-0.029**	-	-0.027***	-	-0.007*	-	-0.017*
		(0.020)		(0.013)		(0.009)		(0.004)		(0.010)
$EMU^{ELECTRONIC}$	-	0.038	-	-0.024	-	-0.020	-	-0.022***	-	-0.053***
		(0.031)		(0.021)		(0.014)		(0.006)		(0.015)
$EMU^{PHYSICAL}$	-	0.008	-	-0.033**	-	-0.034***	-	-0.035***	-	-0.085***
		(0.021)		(0.015)		(0.008)		(0.005)		(0.012)
$EMU^{OVERALL}$	0.009	-	-0.033**	-	-0.033***	-	-0.030***	-	-0.068***	-
	(0.021)		(0.014)		(0.008)		(0.005)		(0.011)	
Trade	-0.129***	-0.095***	-0.114***	-0.112***	-0.125***	-0.121***	-0.043***	-0.041***	-0.097***	-0.099***
	(0.014)	(0.015)	(0.032)	(0.032)	(0.022)	(0.022)	(0.010)	(0.010)	(0.023)	(0.024)
Finance	0.029*	0.018	-0.003	-0.002	-0.005	-0.003	0.028***	0.024***	0.063***	0.058***
	(0.016)	(0.017)	(0.012)	(0.012)	(0.008)	(0.008)	(0.004)	(0.004)	(0.009)	(0.010)
Technology	0.005	0.014	0.011	0.008	0.011	0.007	0.013	0.011	0.029	0.027
	(0.020)	(0.021)	(0.026)	(0.026)	(0.018)	(0.018)	(0.009)	(0.009)	(0.021)	(0.022)
GDPCAP	-0.137	-0.078	0.723**	0.856***	0.605***	0.720***	1.421***	1.296***	3.215***	3.138***
	(0.268)	(0.250)	(0.310)	(0.311)	(0.189)	(0.188)	(0.126)	(0.124)	(0.285)	(0.300)
$GDPCAP^2$	0.004	0.002	-0.036**	-0.043***	-0.031***	-0.036***	-0.070***	-0.064***	-0.158***	-0.155***
	(0.014)	(0.013)	(0.016)	(0.016)	(0.009)	(0.009)	(0.007)	(0.006)	(0.016)	(0.015)
Urbanisation	-0.003***	-0.003***	-0.000	-0.000	-0.000	-0.000	-0.014***	-0.013***	-0.032***	-0.031***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
EU	0.109***	0.118***	0.049***	0.047***	0.047***	0.045***	0.023***	0.020***	0.052***	0.048***
	(0.019)	(0.019)	(0.015)	(0.014)	(0.009)	(0.009)	(0.005)	(0.005)	(0.011)	(0.012)
WTO	0.002	0.005	-0.042*	-0.039	-0.033**	-0.029*	0.007**	0.005	0.016**	0.012
	(0.024)	(0.024)	(0.023)	(0.025)	(0.016)	(0.017)	(0.003)	(0.003)	(0.007)	(0.007)
SPI	-0.003***	-0.004***	-0.003***	-0.003***	-0.003***	-0.003***	-0.002***	-0.002***	-0.005***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ESF	-0.088***	-0.069***	-0.027**	-0.027**	-0.021***	-0.022***	-0.008**	-0.009**	-0.018**	-0.022**
	(0.025)	(0.024)	(0.013)	(0.013)	(0.008)	(0.008)	(0.004)	(0.004)	(0.009)	(0.010)
Crisis	0.029*	0.022	0.004	0.003	0.004	0.004	0.006**	0.006**	0.014**	0.015**
	(0.017)	(0.016)	(0.058)	(0.058)	(0.011)	(0.011)	(0.003)	(0.003)	(0.007)	(0.007)
Time FE	NO	NO	YES***	YES***	YES***	YES***	YES***	YES***	YES***	YES***
Country FE	NO	NO	YES***	YES***	YES***	YES***	-	-	-	-

JP	-	-	-	-	[0.207]	[0.401]	[0.873]	[0.831]	[0.873]	[0.831]
AR(1)	-	-	-	-	-	-	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	-	-	-	-	-	-	[0.171]	[0.144]	[0.171]	[0.144]
HP	-	-	[0.000]	[0.000]	[0.000]	[0.030]	[0.000]	[0.000]	[0.000]	[0.000]
RMSE	0.123	0.119	0.065	0.064	0.061	0.061	0.060	0.059	0.060	0.059
N	1206	1206	1206	1206	1171	1171	1150	1150	1150	1150

Source: Authors' own computation.

Notes: Time FE and Country FE indicate whether yearly and country fixed effects are included. JP corresponds to the p-value for Hansen's (1982) J-test for over-identifying restrictions. AR(1) and AR(2) are the p-values for first- and second-order autocorrelation tests under GMM-FD estimation. HP reports the p-value for Hausman's (1978) endogeneity bias test. RMSE corresponds to the root mean squared error. Heteroscedasticity and autocorrelation robust standard errors are reported (in parentheses). Significance is indicated by: * (10%), ** (5%), ***.

6.3 Additional Estimations

A number of additional estimations are conducted for robustness in Table 3. First, full sample cross-sectional estimation is conducted and results are reported in column (1). Additionally, cross-sectional estimation is conducted on a yearly basis, and estimates are subsequently averaged across years from 1999 until 2013. Standard errors are corrected for serial correlation following Chakravarty et al. (2004) by multiplying them by $\{[1+\Phi]/[1-\Phi]\}^{1/2}$, where Φ is the autocorrelation of the relevant temporal estimate with its first lag. See column (2). Second, fixed effects estimations are conducted and reported in columns (3)-(4) by averaging panel data over five-year intervals. For comparison, various full sample fixed effects estimations based on annual data are reported in columns (5)-(8). Third, questions arise about robustness with respect to alternative datasets and measures of inequality/polarisation (see Jenkins, 2015, for a critical discussion). Therefore, we re-estimate using instead the Gini index and the P80/P20 quintile ratio from the WIID database, i.e. the ratio of income earned by the top fifth of the population ranked by increasing income, to that earned by the bottom fifth (see Bertola, 2010). All measures are increasing in the extent of inequality and are correlated with coefficients of 0.8 (Gini SWIID vs Gini WIID), 0.7 (Gini SWIID vs P80/P20 WIID) and 0.8 (Gini WIID vs P80/P20 WIID). See columns (9)-(11). We also re-estimate using SWIID version 6.1, which covers the years up to 2015 for most countries and includes relatively recent EMU enlargement rounds involving Latvia and Lithuania, as in column (12).[17] However, similar results are obtained using different inequality/polarisation measures. The results highlight again the predominance of economic and monetary integration channels, while providing further support for fixed effects panel data methods over pooled alternatives.

6.4 Country-Group Estimation Results

The country-group results are presented in Table 4 based on static (LSDV and GMM-2S) estimation in columns (1)-(3) and dynamic (GMM-FD) estimation in columns (6)-(7). For robustness, we consider also the Gini index and the P80/P20 quintile ratio from the WIID database in columns (4)-(5). The estimation output reveals considerable heterogeneity in the magnitude and significance of monetary and market integration effects across different country-groups. The results, which are discussed below, are robust to outliers when Huber's (1964) fixed effects outlier-robust estimator is utilised instead (see Table A1, as in the Appendix).

Monetary integration has significantly different effects on EMU core- and non-core country-groups. Dummy variables EMU^{CORE} and $EMU^{NON\text{-}CORE}$ in Table 4 take a value of unity from 1999 (or from the year of euro currency adoption for subsequent adoptees) to 2013; and zero in preceding years.[18] EMU membership has directly reduced income inequality in non-core countries by 3% in the short-run; and by 11% in the long-run, as in columns (5)-(6). However, the inequality implications are significantly less favourable for the core country-group according to t-test outcomes.[19] See also Figures A2-A3 (as in the Appendix), which highlight the different response-paths of inequality in the core and non-core country-groups following a monetary integration shock that corresponds to EMU membership.

The findings for monetary integration are consistent with a growing number of studies, which document qualitatively different income inequality trends within EMU countries (see, for example, OECD, 2008; see also Eurofound, 2017). These outcomes are not inconsistent with the prediction that monetary integration encourages labour market reform and higher

inequality in capital-rich countries, as they implement policies to deregulate domestic labour markets (Bertola, 2016). EMU's institutional and political environments also encourage deflationary adjustment and wage restraint as the older member states try to maintain their competitive positions vis-à-vis newer member states; whereas the fixing of exchange rates and capital inflows associated with monetary union have encouraged debt-driven consumption, investment and higher wages outside of the core until the onset of the GFC (Matthijs, 2016). From a monetary policy credibility perspective, the non-core countries expect to benefit most from credibility of the ECB, and therefore have less incentive to undertake labour market reforms (Calmfors, 2001).

A doubling of trade openness significantly reduces inequality in EMU non-core countries by 15-20%; however, the inequality implications are significantly less favourable for the core country-group according to t-test outcomes. These results accord with international trade theory, whereby the relative abundance of skilled and unskilled workers accounts for the differing outcomes in the core and non-core country-groups, respectively (Stolper and Samuelson, 1941). An alternative perspective is that core countries can more easily import products made elsewhere, which has encouraged substitution of foreign workers for domestic workers, while reducing the bargaining power of workers in the core countries (see, for example, Rodrik, 1997). Therefore, the growing economic integration of the Central and Eastern European countries and Baltic States has contributed to increasing inequality in the core countries; whereas, increased demand for labour outside of the core has increased workers' bargaining power elsewhere. These trends halted during the GFC when the collapse in world trade coincided with sizeable increases in inequality, especially in many non-core countries.

Estimates for technical integration are positively signed, which corroborates up to a point the skill-biased change hypothesis (Bound and Johnson, 1992). To the extent that the involvement of households in high-tech exports reinforces the earnings of high-skilled workers relative to low-skilled workers, technical integration has increased inequality via a wage premium, but only in the most advanced, core economies. This is not unsurprising in that the relationship between technological innovation and inequality is likely to be strongest in the most developed countries, where technological diffusion is broader and productivity improvements are more rapidly incorporated into wages. Yet this channel is often insignificant, as is the difference in integration effects between EMU core and non-core country-groups. Therefore, the technical integration channel appears to be rather weak, which contrasts with previous empirical findings (see, for example, Jaumotte et al., 2013). Our findings for primary income inequality among households are more in line with Stockhammer's (2017) findings for functional inequality and the wage share.

Table 3. Comparison of Cross-Sectional, Panel Averaging, Fixed Effects and Alternative Inequality/Polarisation Estimates

	Cross-Sectional		Panel Averaging		Fixed Effects				Alternative Inequality/Polarisation			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
FIX	-0.020	-0.044	-0.039**	-0.038**	-0.031**	-0.029**	-0.027***	-0.017*	-0.045***	-0.027**	-0.030**	-0.019*
	(0.038)	(0.041)	(0.020)	(0.017)	(0.014)	(0.013)	(0.009)	(0.010)	(0.011)	(0.012)	(0.014)	(0.010)
$EMU^{ELECTRONIC}$	-	-	-0.041**	-0.020	-0.008	-0.024	-0.020	-0.053***	-0.025***	-0.021**	-0.026**	-0.029***
			(0.021)	(0.018)	(0.018)	(0.021)	(0.014)	(0.015)	(0.008)	(0.010)	(0.011)	(0.009)
$EMU^{PHYSICAL}$	-	-	-0.032	-0.035	-0.027**	-0.033**	-0.034***	-0.085***	-0.034**	-0.031*	-0.050**	-0.021***
			(0.043)	(0.033)	(0.013)	(0.015)	(0.008)	(0.012)	(0.013)	(0.019)	(0.021)	(0.005)
$EMU^{OVERALL}$	-0.072	-0.053	-0.045**	-0.042**	-0.025**	-0.033**	-0.033***	-0.068***	-0.024**	-0.022*	-0.024**	-0.033***
	(0.053)	(0.058)	(0.023)	(0.019)	(0.013)	(0.014)	(0.008)	(0.011)	(0.010)	(0.013)	(0.012)	(0.005)
Trade	-0.104**	-0.110**	-0.142***	-0.120***	-0.102***	-0.112***	-0.121***	-0.099***	-0.079***	-0.101***	-0.096***	-0.052***
	(0.050)	(0.051)	(0.051)	(0.042)	(0.028)	(0.032)	(0.022)	(0.024)	(0.025)	(0.027)	(0.034)	(0.014)
Finance	0.041	0.010	-0.017	-0.001	0.008	-0.002	-0.003	0.058***	0.034***	0.036***	0.034**	0.033***
	(0.049)	(0.062)	(0.024)	(0.018)	(0.011)	(0.012)	(0.008)	(0.010)	(0.007)	(0.010)	(0.014)	(0.006)
Technology	0.023	0.016	0.011	0.010	0.016	0.008	0.007	0.027	0.023	0.014	0.021	0.023**
	(0.046)	(0.047)	(0.034)	(0.030)	(0.026)	(0.026)	(0.018)	(0.022)	(0.033)	(0.025)	(0.025)	(0.011)
EU	0.053*	0.051*	0.044***	0.045***	0.047***	0.047***	0.045***	0.048***	0.032***	0.033***	0.031***	0.034***
	(0.031)	(0.027)	(0.016)	(0.014)	(0.008)	(0.014)	(0.009)	(0.012)	(0.011)	(0.010)	(0.012)	(0.007)
SPI	-0.003*	-0.004**	-0.003**	-0.004***	-0.003***	-0.003***	-0.003***	-0.005***	-0.002**	-0.002**	-0.002***	-0.001***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)
ESF	-0.034	-0.035	-0.032**	-0.024**	-0.038***	-0.027**	-0.022***	-0.022**	-0.022**	-0.020**	-0.020**	-0.016**
	(0.027)	(0.026)	(0.015)	(0.013)	(0.012)	(0.013)	(0.008)	(0.010)	(0.011)	(0.008)	(0.009)	(0.006)
IV Estimation	NO	NO	NO	YES	NO	NO	YES	YES	NO	YES	YES	YES
Time FE	-	-	YES***	YES***	NO	YES***	YES***	YES***	YES***	YES***	YES***	YES***
Country FE	-	-	YES***	YES***	YES***	YES***	YES***	-	YES***	YES***	YES***	YES***
N	34	510	252	220	1206	1206	1171	1150	972	937	811	1159

Source: Authors' own computation.

Notes: Columns (1)-(2), full sample OLS cross-sectional estimation and aggregated estimation over individual years, respectively; columns (3)-(4), five-year panel averaging LSDV and GMM-2S estimations; columns (5)-(8), fixed effects variations, including static GMM-2S estimation in column (7) and dynamic GMM-FD estimation in column (8). Columns (1)-(8) based on SWIID version 5.1. Columns (9)-(10), LSDV and GMM-2S estimations using Gini index from WIID version 3.4. Column (11), GMM-2S estimation using P80/P20 quintile ratio from WIID version 3.4. Column (12), GMM-2S estimation using SWIID version 6.1. The estimates for $EMU^{OVERALL}$ are obtained from separate regressions, but reported in this table alongside $EMU^{ELECTRONIC}$ and $EMU^{PHYSICAL}$ to conserve space. $GDPCAP_{i,t}$, $GDPCAP^2_{i,t}$, $Urbanisation_{i,t}$, $WTO_{i,t}$ and $Crisis_{i,t}$ control variables are included, but corresponding estimates are not reported for brevity. Time FE and Country FE indicate whether yearly and country fixed effects are included. Standard errors in column (2) are corrected by multiplying by $\{[1+\Phi]/[1-\Phi]\}^{1/2}$, where Φ is the first-order autocorrelation of the relevant temporal coefficient estimate. Heteroscedasticity and autocorrelation robust standard errors are reported (in parentheses). Significance is indicated by: * (10%), ** (5%), *** (1%).

Interestingly a doubling of financial openness increases income inequality in the periphery and candidate countries by 2-12%; whereas it has the opposite effect on the core countries, reducing inequality by 2-4%. The difference in parameter estimates for EMU core and other European country-groups is also statistically significant. These outcomes differ from the traditional (neoclassical) prediction that financial integration encourages a more efficient allocation of capital, which increases growth and reduces inequality (Beck et al., 2007). Financial liberalisation has exacerbated inequality first and foremost in periphery and candidate country-groups, which may reflect uneven access to finance and greater household income inequality following asymmetric shocks in these countries (Furceri and Loungani, 2015). These results also support the perspective that financial liberalisation and financialisation have exposed many countries to macroeconomic and financial instability, which has impacted disproportionately on the least developed countries (Arestis and Sawyer, 2005).

Table 4. Disaggregated Estimation Output for Country-Groups

	Static Estimation				Dynamic Estimation	
	LSDV	GMM-2S	GMM-2S	GMM-2S	GMM-FD (Short-Run)	GMM-FD (Long-Run)
	(1)	(2)	(3)	(4)	(5)	(6)
L.Gini	-	-	-	-	0.685***	-
					(0.017)	
EMU^{CORE}	**0.008**	**0.006**	**0.011**	**0.018**	**0.007**	**0.022**
	(0.014)	**(0.015)**	**(0.015)**	**(0.016)**	**(0.007)**	**(0.022)**
$EMU^{NON-CORE}$	**-0.048*** **	**-0.035** **	**-0.041** **	**-0.040** **	**-0.034*** **	**-0.108*** **
	(0.016)	**(0.016)**	**(0.018)**	**(0.019)**	**(0.010)**	**(0.032)**
$Trade^{ROW}$	-0.050**	-0.047*	0.016	0.025	-0.069***	-0.219***
	(0.023)	(0.026)	(0.027)	(0.028)	(0.013)	(0.041)
$Trade^{EMU-CORE}$	**0.033**	**0.011**	**0.022**	**0.038**	**0.022**	**0.070**
	(0.031)	**(0.036)**	**(0.037)**	**(0.041)**	**(0.019)**	**(0.060)**
$Trade^{EMU-PERIPHERY}$	**-0.209*** **	**-0.282*** **	**-0.184*** **	**-0.171*** **	**-0.090*** **	**-0.286*** **
	(0.028)	**(0.032)**	**(0.033)**	**(0.035)**	**(0.016)**	**(0.051)**
$Trade^{EMU-CANDIDATE}$	**-0.196*** **	**-0.262*** **	**-0.213*** **	**-0.258*** **	**-0.080*** **	**-0.254*** **
	(0.037)	**(0.046)**	**(0.045)**	**(0.051)**	**(0.019)**	**(0.060)**
$Finance^{ROW}$	0.037***	0.037***	0.026**	0.023*	0.017***	0.054***
	(0.012)	(0.013)	(0.013)	(0.013)	(0.005)	(0.016)
$Finance^{EMU-CORE}$	**-0.105*** **	**-0.104*** **	**-0.041*** **	**-0.062*** **	**-0.017***	**-0.054***
	(0.014)	**(0.015)**	**(0.017)**	**(0.021)**	**(0.009)**	**(0.029)**
$Finance^{EMU-PERIPHERY}$	**0.029*** **	**0.037*** **	**0.035** **	**0.071*** **	**0.014*** **	**0.044*** **
	(0.011)	**(0.012)**	**(0.017)**	**(0.024)**	**(0.005)**	**(0.016)**
$Finance^{EMU-CANDIDATE}$	**0.037*** **	**0.061*** **	**0.040** **	**0.042** **	**0.047*** **	**0.149*** **
	(0.014)	**(0.018)**	**(0.017)**	**(0.019)**	**(0.007)**	**(0.022)**
$Technology^{ROW}$	0.017	0.021	0.015	0.032**	0.004	0.013
	(0.014)	(0.015)	(0.014)	(0.016)	(0.006)	(0.019)
$Technology^{EMU-CORE}$	0.019	0.014	0.019	0.020	0.011*	0.035*
	(0.014)	(0.011)	(0.015)	(0.017)	(0.006)	(0.019)
$Technology^{EMU-PERIPHERY}$	0.016	0.014	0.020	0.008	0.008	0.025
	(0.011)	(0.012)	(0.013)	(0.014)	(0.007)	(0.022)
$Technology^{EMU-CANDIDATE}$	-0.007	-0.007	0.020	0.013	-0.003	-0.010
	(0.009)	(0.009)	(0.015)	(0.016)	(0.005)	(0.016)
GDPCAP	0.818***	0.649***	0.814***	0.922***	0.478***	1.517***
	(0.212)	(0.205)	(0.229)	(0.245)	(0.124)	(0.394)
$GDPCAP^2$	-0.040***	-0.032***	-0.042***	-0.044***	-0.024***	-0.076***
	(0.010)	(0.010)	(0.012)	(0.014)	(0.007)	(0.022)
Urbanisation	0.001	0.000	0.001	0.001	-0.003***	-0.010***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.003)
EU	0.043***	0.040***	0.038***	0.035***	0.008*	0.025*
	(0.009)	(0.009)	(0.011)	(0.012)	(0.004)	(0.013)
WTO	-0.037**	-0.032*	-0.030	-0.017	0.008**	0.025**
	(0.017)	(0.018)	(0.021)	(0.013)	(0.003)	(0.010)
SPI	-0.002***	-0.003***	-0.002**	-0.002**	-0.001***	-0.003***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
ESF	-0.025***	-0.021**	-0.022**	-0.024**	-0.015***	-0.048***
	(0.009)	(0.009)	(0.011)	(0.012)	(0.004)	(0.013)
Crisis	0.101***	0.002	0.004	0.008	0.007**	0.022**
	(0.038)	(0.010)	(0.013)	(0.014)	(0.003)	(0.010)
Time FE	YES***	YES***	YES***	YES***	YES***	YES***
Country FE	YES***	YES***	YES***	YES***	-	-
JP	-	[0.149]	[0.131]	[0.102]	[0.703]	[0.703]
AR(1)	-	-	-	-	[0.000]	[0.000]
AR(2)	-	-	-	-	[0.116]	[0.116]
RMSE	0.060	0.056	0.080	0.097	0.055	0.055
N	1206	1171	937	811	1150	1150

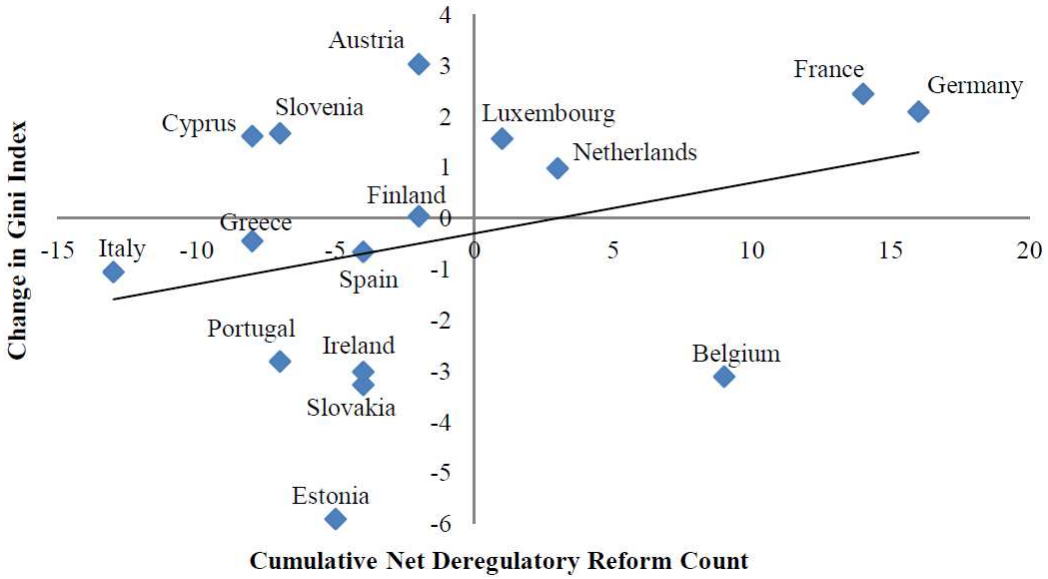
Source: Authors' own computation.

Notes: Time FE and Country FE indicate whether yearly and country fixed effects are included. The country fixed effects and country-group specific dummy variables are included in LSDV and GMM-2S, but eliminated under GMM-FD and are otherwise not reported for brevity. GMM-2S estimation in column (2) employs the Gini index from SWIID version 5.1; GMM-2S estimation in column (3) uses the Gini index from WIID version 3.4; whereas GMM-2S estimation in column (4) uses instead the P80/P20 index from WIID version 3.4. A t-test is conducted to infer whether EMU core and non-core/candidate country-group coefficient estimates differ at the 5% significance level for each of the integration variables; rejection of the null hypothesis of equality is indicated in bold text. JP corresponds to the p-value for Hansen's (1982) J-test for over-identifying restrictions. AR(1) and AR(2) are the p-values for first- and second-order autocorrelation tests under GMM-FD estimation. RMSE corresponds to the root mean squared error. Heteroscedasticity and autocorrelation robust standard errors are reported (in parentheses). Significance is indicated by: * (10%), ** (5%), *** (1%).

6.5 Further Analysis and Explanation

At this point the EMU effect effectively remains unexplained. One possibility is that deregulation and labour market reform, which have not been explicitly modelled due to data limitations, account for the differing monetary integration outcomes in the core of EMU and beyond. In order to shed some light on this issue, we utilise the LABREF database as detailed in Turrini et al. (2015), which covers only the EU countries. We consider for each country that has adopted the euro currency over the period 1999-2013 the cumulative net country-specific count of deregulatory reforms, as in Bertola (2016).[20] The composite indicator is based on the following categories of reform: (1) job protection; (2) labour taxation; (3) unemployment benefits; (4) wage setting; (5) working time; and (6) other welfare-related benefits. We compute changes in the unexplained component of inequality from the point of euro currency adoption until 2013 for each EMU member state; and plot these changes against the cumulative net count of deregulatory reforms within these countries that occurred during the first five years of EMU membership (see Figure 1).[21,22]

Figure 1: EMU Membership, Inequality and Deregulatory Reform



Source: Authors' own computation using data as detailed in section 4 and data from the LABREF database, DG EMPL, European Commission.

Figure 1 reveals a positive correlation between changes in the Gini index and net deregulatory reform. On the one hand, numerous countries in the core of EMU, including

Germany, France, Netherlands and Luxembourg, have experienced deregulation and growth in inequality, even after accounting for other market integration effects and the GFC. On the other hand, countries like Portugal, Slovakia, Estonia and Ireland, have experienced lower rates of deregulation or even a tightening in labour market regulations, combined with lower inequality. These arguments corroborate the perspective that monetary union has encouraged deflationary policies and wage restraint first and foremost in the EMU core countries (Bertola, 2016); whereas other countries, which are mainly located outside of the core, have not followed the same path of reform, at least until the GFC (see also Matthijs, 2016). There are some deviations from this trend, which may reflect the presence of other unobservable influences that have impacted on inequality over the same timeframe.

6.6 Inequality Implications

To provide some early projections and comparison for European country-groups, including the current group of EMU candidate countries, we compute 90%, 95% and 99% confidence intervals for monetary and market integration effects on inequality using the aggregated and country-group results under dynamic GMM-IV estimation in Table 2 and Table 4. We consider (trade, financial and technical) openness gains of up to 30% as the most optimistic scenario, although various scenarios are considered (see, for example, Glick and Rose, 2016 and Kalemli-Ozcan et al., 2010).[23] In what follows below we summarize the minimum and maximum projections arising under the 95% confidence interval.[24]

Monetary integration increases the Gini index directly by up to 6.5% in the EMU core country-group; whereas it reduces the inequality index by up to 17.1% in the non-core and candidate country-groups. When monetary and market integration coincides – where the latter corresponds to a joint 30% expansion in trade, financial and technical openness – the Gini index decreases by up to 26% in candidate countries, implying considerable distributional benefits for these countries following enlargement. This reflects primarily the positive monetary and economic integration channels, which supersede financial and technical integration channels. The latter is relatively unimportant in generating changes in inequality. Moreover, the upside potential for the candidate county-group via monetary and economic integration is favourable, both in absolute terms and relative to the core country-group, where inequality increases overall by up to 14%. This accords with the paradigm that monetary union has created incentives for deregulation, labour market reform and wage restraint in core countries, as in Germany, as these countries try to retain competitiveness vis-à-vis the new member states (Bertola, 2016 and Matthijs, 2016). Our projections also corroborate in an EMU enlargement context the recent evidence elsewhere that technical integration is not the main driver of inequality (see, for example, Stockhammer, 2017).

The projection outcomes are consistent with the evolving trends in intra-national inequality, especially in numerous EU accession countries and countries adopting the euro currency in subsequent enlargement rounds (see, for example, OECD, 2008; see also Eurofound, 2017, p. 45).

7. Summary and Conclusions

The conventional viewpoint that European monetary integration would facilitate international income convergence has received much attention from academics and policy-makers; however, its impact on intra-national income inequality has received relatively little attention. This is despite substantial expansions in market integration among European countries during

the monetary integration process and uneven trends in inequality, which are emerging within individual countries. Against this backdrop, this paper provides a robust reassessment of the inequality implications associated with monetary integration, both realised and expected over coming years.

This study's finding that EMU has reduced inequality in the average member state contrasts with previous empirical studies for three main reasons. First, earlier work primarily relies on pooled regression analysis; however, this generates significant omitted-variables bias. Second, the inequality effects have increased over time; however, previous studies do not distinguish between the short- and long-run monetary integration effects, even though the latter are notably larger. Third, and most fundamentally, the EMU effects differ qualitatively in core and non-core country-groups. The relatively unfavourable implications of integration in the core countries, which have received most attention in the literature, contrast sharply with the more favourable implications elsewhere. This includes countries adopting the euro currency in subsequent enlargement rounds, and the current group of EMU candidate countries. Our results can be related to older and newer theoretical perspectives that predict different inequality outcomes according to international comparative advantages and changes in labour markets following euro currency adoption. Our findings corroborate the viewpoint that the move to monetary union has encouraged deflationary adjustment, labour market reform and wage restraint in the core countries; whereas the relatively new member states in Central and Eastern Europe and the Baltic States have benefitted from economic integration and a tightening of labour market regulations.

In conclusion academics, policy-makers and politicians should consider a broader debate about the cost-benefit analysis of euro adoption, since it may affect the level, growth rate and also the distribution of income across and within countries. Interestingly, our analysis implies that EMU candidate countries could over time benefit from economic and monetary union by much more than had previously been acknowledged. However, the distributional benefits to prospective member states do not appear to be independent of the costs to the current incumbents. Thus, in the absence of alternative adjustment and social support mechanisms, EMU could play a part in undermining its own longevity by exacerbating inequality further within its core.

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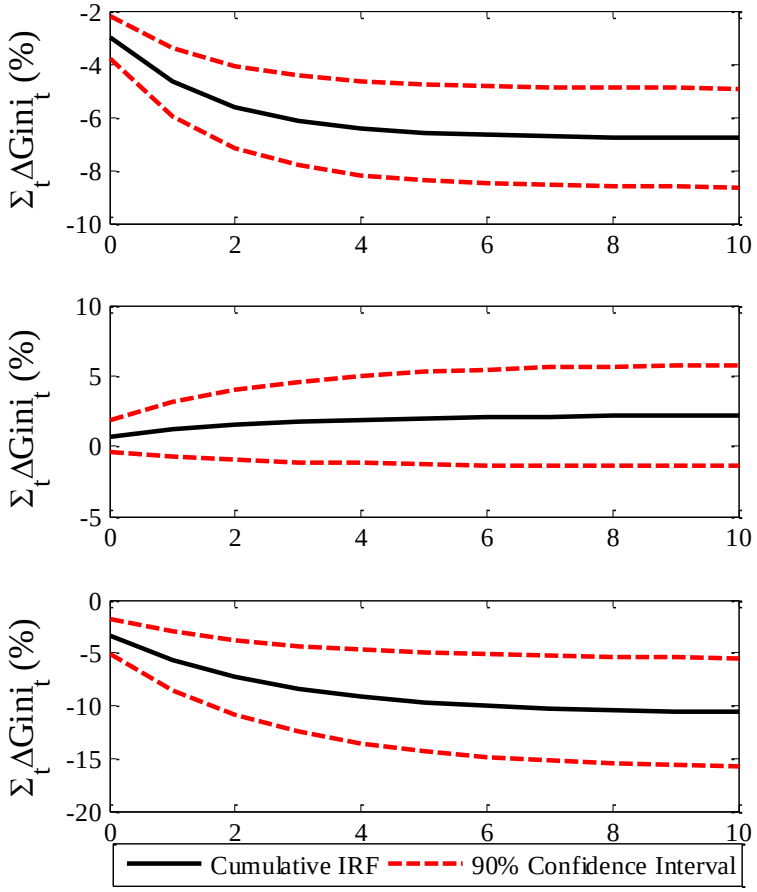
Appendix

Figures A1-A3. Cumulative impulse response functions for EMU-All (top), EMU-Core (middle) and EMU-Non-Core (bottom) household income inequality in following a monetary integration shock.



Source: Authors' own computation.

Notes: Figures A1-A3 correspond to cumulative changes in the Gini index (%) arising from a unitary shock to the dummy variable $EMU_{i,t}^{OVERALL}$, which are computed as $100\sum_t \hat{\beta}\hat{\rho}^t$, along with the 90% confidence intervals. EMU-All corresponds to the GMM-FD aggregated estimation in Table 2; whereas EMU-Core and EMU-Non-Core correspond to GMM-FD country-group estimation in Table 4. The horizontal axis represents years since adoption of the euro currency.

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[1] If one considers the 2004, 2007 and 2013 EU acceding countries of Czech Republic, Hungary, Poland, Bulgaria, Romania and Croatia, which are all obliged to adopt the euro after satisfying the Maastricht Criteria for convergence, this would involve a substantial increase on the current membership of 19 EMU countries.

[2] These trends in inequality may reflect a multitude of factors, including monetary and market integration forces; and related labour market reforms implemented, for instance, in Germany during the early 2000s. Matthijs (2016) notes similar trends not just for Germany but for other core countries, such as Luxembourg and the Netherlands.

[3] For example, Bouvet (2010) analyses inter-regional inequality for 13 countries, employing a least squares regression methodology with country fixed effects over the period 1977-2003. While the euro's (electronic) introduction has had no significant effect on spatial inequality, a significant and unfavourable interaction between EU cohesion funding and EMU membership is identified. The increased competition arising from monetary integration may have contributed to increasing inequality in the poorest parts of Europe, since only the richest regions can withstand international competition (Bouvet op. cit., p. 338). Ezcurra and Pascual (2008) analyse spatial inequality in the pre-euro currency period using a panel fixed effects methodology for 12 European countries over the period 1980-1999, using the coefficient of variation constructed from regional income data. EU structural funds have reduced spatial inequality; whereas fiscal consolidation has increased it. More recently, Agnello et al. (2016) analyse spatial inequality and its relationship with fiscal consolidation for

13 EU countries over the period 1980-2008, but use a dynamic panel data methodology. Fiscal consolidation associated with the EU has exacerbated inter-regional inequalities, both in the short- and long-run; but by considerably more over time due to the temporal persistence of inequality. However, Agnello et al.'s (op. cit.) primary contribution relates to national fiscal consolidation rather than monetary and market integration, which is the focus of the current paper.

[4] Probably the most closely related study to ours is that of Bertola (2010), which analyses household income inequality for 14 EU countries over the period 1995-2005. On the basis of pooled estimation, Bertola (op. cit.) concludes that income inequality has slightly increased among EMU member states due to less general social policies that have arisen over the same period. Bouvet (2010) analyses income convergence among regions rather than households in 13 EU countries over the period 1977-2003 using a panel fixed effects methodology. The identified EMU effect on regional inequality is rather weak and close to zero. Added to which, regions with EU funds for cohesion have experienced higher inequality; however, regions with higher inequality are also more likely to meet the criteria for accessing cohesion funds. Additionally, and at the same time, trade, financial integration, and technological diffusion may be associated with both monetary integration and income inequality; yet, the strength of different integration channels remains uncertain empirically. In another study, Stockhammer (2017) explores determinants of the wage share for OECD countries (rather than household income inequality) and accounts for various forms of integration, excluding monetary integration, which is not the primary focus of Stockhammer (op. cit.). Furthermore, the temporal persistence of inequality is not addressed methodologically in these studies; nor do they distinguish between short- and long-run inequality implications of integration. Only Bertola (op. cit.) and Bouvet (op. cit.) provide empirical estimates of the EMU effect; but the size and significance of different theoretical channels related to monetary integration may have become more heterogeneous as its membership has evolved; and inequality may continue to evolve heterogeneously across and within the prospective enlarged EMU.

[5] By comparison the New Economic Geography approach is more relevant to spatial income inequality across countries and regions, rather than income inequality among households within individual countries, which is the focus of our study.

[6] Monetary integration effects are considered for EMU core and non-core country-groups.

[7] Fixed effects specifications also help account for numerous factors that tend to be relatively time-invariant, such as whether a minimum-wage policy is in place or not or the extent of involvement in trade unions.

[8] Our baseline analysis is conducted using SWIID version 5.1; however, to provide some comparison, and for robustness, we also explore different inequality/polarisation measures and databases in section 6.3.

[9] Fixed exchange rate regimes are based on the fine classification codes 1-11.

[10] Data are available for all countries and most of the sample period is covered, although we extrapolate for some of the earlier years as necessary. In doing so, we observe that the variation in technical integration occurs primarily across countries rather than over time.

[11] The annual reports and ex post evaluations of the European Social Fund are publically available from the Archive of European Integration and European Commission websites.

[12] Data taken from the WDI are scaled in constant 2005 US Dollars.

[13] IV estimation is supported by instrument validity tests and first- and second-order autocorrelation tests in Table 2 and Table 4. Up to two period lags of endogenous regressors are used as instruments under static and dynamic GMM-IV, where $Trade_{i,t}$, $Finance_{i,t}$, $Technology_{i,t}$, $SPI_{i,t}$ and $ESF_{i,t}$ are treated as endogenous regressors.

[14] Granger's (1969) test operates under the null hypothesis of no conditional correlation between $Gini_{i,t}$, $Trade_{i,t}$, $Finance_{i,t}$, $Technology_{i,t}$, $SPI_{i,t}$ and $ESF_{i,}$ based on regression analysis using a one period lag of the explanatory variables.

[15] Hausman's (1978) test operates under the null hypothesis that pooled and fixed effects estimates do not differ significantly. The test statistic is based on the ratio of the squared difference of the point estimates and estimated variances obtained from POLS and fixed effects estimations. In the case of the dynamic estimation, we compare the estimates from GMM-FD with those obtained from dynamically specified POLS estimation.

[16] The country fixed effects are removed under GMM-FD by the first-differencing procedure.

[17] SWIID version 6.1 contains data up to 2015 for most countries in this paper's sample. The results in Table 3 are very similar. See column (12) versus column (7) for comparison under GMM-IV. See also Table A2 in the Appendix for different models. But there are fewer data points in version 6.1 during the earlier years of the sample for certain countries; and fewer countries are covered in the 1970s.

[18] When we include a separate EMU dummy variable for the periphery country-group, the estimates are qualitatively and quantitatively similar to the non-core country-group as in Table 4, and the difference is not statistically significant. However, there is some evidence of multicollinearity when we model separately the periphery country-group, which leads us to prefer a simpler model specification.

[19] A t-test is conducted to infer whether EMU core and non-core/candidate country-group coefficient estimates differ at the 5% level of significance for each integration variable. Rejection of the null hypothesis of equality is indicated in Table 4 in bold text.

[20] That is, for each deregulatory reform, the count increases by one; but it decreases if a reform tightens labour market regulation.

[21] We first regress the dependent variable $Gini_{i,t}$ on all market integration variables and other controls, including the dummy variable for the GFC, and fixed effects as in equation (1). But we exclude the EMU dummy variable; therefore, the residual from this regression is the unexplained component of inequality that is partially associated with monetary integration, among other factors. From this we determine the change in the Gini index from the year of euro currency adoption until 2013. Similar results arise if we partial out in a similar way the impact of explanatory variables on net deregulatory reform; or if we plot the net deregulatory reform against changes in the Gini index, which corresponds to the unconditional association.

[22] The net deregulatory reform is computed for all countries during the first five years of EMU membership, except for Estonia, which adopted the euro currency in 2011; therefore, we analyse changes in inequality and net deregulatory reform between 2011 and 2013. The results are similar if instead we compute deregulatory reform over a three-year window for all other countries too.

[23] Some caution is needed as the long-term trade, finance and technical integration gains remain uncertain.

[24] The full set of projection results is available in a supplementary appendix, which is available from the authors upon request.