The Real Effects of Financial (Dis)integration:
A Spatial Equilibrium Analysis of Europe

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Abstract
Using data from 15 European Union economies, we quantify the real effects of supply side frictions in bank lending due to financial separation of European countries since the 2008 financial crisis. We develop a spatial equilibrium model with heterogeneous countries. Banks allocate capital endogenously across countries, which in turn determines the cost of capital of firms and the wealth of nations. The cost of financial segmentation is reduced access to capital for firms and a resulting fall in output. We show that financial segmentation can explain about 22.6\% of the output gap in the EU countries since the crisis. We also estimate the benefits of further financial integration to the European economy.

Keywords: Globalization, Global Financial Crisis, Europe, Eurozone, Cross-border lending.


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1. Introduction

Globalization and a more integrated Europe have been important policy goals, until the 2008 financial crisis. During the crisis, policymakers attempted to reduce financial contagion by “ringfencing” risks within national regulatory boundaries. While this helped limit financial contagion, it also created fragmentation of credit markets. After the financial crisis and the sovereign debt crisis, the general policy consensus has been that “financial interconnections can be too destabilizing” (European Commission, 2015). Recent academic literature has also addressed the costs of financial integration (See Bolton and Jeanne, 2011; Farhi and Tirole, 2014; Uhlig, 2014, among others). In sum, financial integration in Europe seems to have unraveled since the financial crisis and the sovereign debt crisis. This paper seeks to analyze the costs of such financial disintegration to the European economy. Such analysis, hopefully, allows a better understanding of the tradeoff involved between systemic risk reduction and costs on the economy due to reduced bank lending.

There are significant parallels and dissimilarities between the U.S. economy and the European Union (EU) economy. Trade in the EU has grown significantly over decades and the economic interdependence is similar to that between U.S. states. The size of the European market is comparable, and in fact a bit larger than the U.S. market. However, unlike that of U.S., the European economy is divided across political boundaries, with each nation deciding policies for its own benefit.

Thus the fall in cross-border lending and financial fragmentation in an economy which is significantly interconnected through trade and labor market channels is a larger concern for the EU than for the U.S. Indeed, the right panel of Figure 1 shows that while business lending in the U.S. has recovered from the crisis and has increased significantly in recent years, business lending in the EU countries has not risen much after the crisis. The left panel of Figure 1 shows that incoming cross-border lending has been falling steadily since the crisis. While a portion of the decline of cross-border lending may be attributable to sovereign risk increase and decline in demand for capital in Europe, this paper seeks to understand what fraction of this difference is due to supply side factors; specifically financial fragmentation.
Two concerns should be addressed before we move forward. First, did cross-border lending fall beyond a general decline in domestic lending? Second, to what extent is the fall explained by a fall in flows to countries with high sovereign risk, such as Greece? Figure 2 shows the fraction of cross-border lending into a country as a fraction of total lending by domestic lenders and cross-border lenders. The argument is that more financially integrated countries receive more cross-border lending, and thus a higher fraction suggests more integration.

The left panel of Figure 2 shows a longer time period and also shows the U.S. in comparison to four major European economies. The right panel focuses on three major economies in continental Europe and shows the decline in financial integration post-crisis in more detail. Germany, which is the largest capital provider to the rest of Europe, did not experience a significant drop in cross-border lending, but France and Spain did. While one may argue that Spain faced sovereign risk and hence lost cross-border capital (BBB+ credit rating from S&P), the right panel shows that the same is true even for France despite its very high credit quality (AA credit rating from S&P). Thus, cross-border lending fell beyond a general decline in domestic lending, and this fall is not specific to countries with high sovereign risk.

The paper seeks to measure the benefits of financial integration in the run-up to the crisis and the costs of fragmentation of credit markets since the crisis. The benefit of financial integration is measured in this paper by an increase in aggregate output. The cost of financial (dis)integration is also measured in the same manner. The paper uses (i) country-specific cross-border lending data, (ii) total factor productivity (TFP) shocks and its correlation across countries, and (iii) country-specific production function data (capital and labor levels and share) to identify changes in supply of credit across political boundaries in Europe.

In order to achieve these goals, the paper develops a spatial equilibrium model. Countries differ based on firm productivity, household capital and labor force characteristics. The key friction is financial, where households from one country can obtain a return on the capital invested in another country based on the level of financial integration between the two countries. Figure 3 shows the fraction of cross-border lending to total lending, which provides moments used to calibrate
financial integration between countries. As can be plainly seen from the picture, incoming cross-border lending as a fraction of total lending (domestic and cross-border) has declined. As domestic interest rates are solved endogenously per country based on the local demand and across our 15 EU country area supply of capital, the financial integration constraints create heterogeneous costs of capital for firms.

We document salient features of commercial and industrial lending in Europe before and after the crisis; and productivity and output patterns in each country in the 15 European Union countries. Data on incoming cross-border lending and total debt securities outstanding is obtained from the Bank for International Settlements (BIS). Data on productivity shocks and correlation between TFP of various countries is obtained from the Penn World Tables (PWT).

Banks allocate capital in our model based on, among other things, productivity in each country and its correlation with other countries, as well as the levels of financial integration with other countries. Therefore, using our model, we calibrate financial integration parameters by matching the observed data moments on banks’ cross-border lending for each country with the corresponding moments generated by the model.

After calibrating the model, we conduct two counter-factual experiments to measure the effects of changes in financial integration on aggregate output. The first experiment estimates the effect of supply side frictions due to financial separation since the crisis. We calibrate the model parameters separately for the time period before the financial crisis and the time period after the financial crisis. These two sets of calibration exercises yield two sets of parameters that govern the degree of financial integration and the real side of the economy before and after the financial crisis. In order to quantify the effects of financial disintegration on outcomes and capital investment, we compare the pre financial crisis world with a counter-factual world where the financial integration level is that of the period post financial crisis. Results show that financial segmentation can explain approximately 22.6% of the output gap in continental European countries since the financial crisis, where output gap is 2.39% in this case. We also evaluate the effects of a fully integrated financial system by comparing the calibrated model economies with a counterfactual scenario where the
countries are fully integrated financially. In this case, the additional output per year is 15.4% of the long run growth rate.

Our work relates to the literature on “sudden stops”. While this literature has focused on emerging economies, the arguments also apply to Europe as it was getting more financially integrated before the crisis and has almost stopped integrating since. In a seminal paper, Calvo (1998) studies the mechanisms that lead to financial crises through a sudden stop in international credit flow. The paper cautioned against greater interdependence between countries without precautionary equity and long term debt buffers that are difficult to withdraw quickly. Christiano, Gust, and Roldos (2004) investigate the effects of interest rate changes during a financial crisis. Neumeyer and Perri (2005) also study the role of interest rates in emerging economies. Chari, Kehoe, and McGrattan (2005) ask whether sudden stops necessarily lead to output drops in a model in which sudden stops are generated by an abrupt tightening of a country’s collateral constraint on foreign borrowing. They find that sudden stops, by themselves, do not lead to decreases in output, but rather to increases. They also find that to generate an output drop during a financial crisis, other frictions are necessary. Mendoza (2010) utilizes an equilibrium business cycle model with a collateral constraint to explain the phenomenon that financial crashes were followed by deep recessions in the sudden stops of emerging economies. He shows that this phenomenon is a result of the amplification and asymmetry that the constraint induces in the responses of macro-aggregates to shocks. He suggests precautionary savings to reduce the likelihood of sudden stops. Our paper contributes to this literature as we discuss the costs of financial disintegration on economic output post crisis.

Our paper also contributes to the literature on the impact of financial institutions on the real economy. Starting with the seminal papers by King and Levine (1993a,b), literature that includes Beck, Levine, and Loayza (2000) and Levine, Loayza, and Beck (2000), among others, has shown that financial intermediaries can promote economic growth. Literature has also established that financial integration and competition between banks help economic growth as they help with greater entry of small businesses (See Jayaratne and Strahan, 1996; Cetorelli and Strahan, 2006; Kerr and Nanda, 2009). Rice and Strahan (2010) show that credit spreads fall and firms are more likely to
borrow from banks after the banks are allowed to cross state lines and compete. Gopalan, Udell, and Yerramilli (2011) show that firms obtain higher loan amounts when they form new banking relationships, while small firms also experience an increase in sales growth, capital expenditure, leverage, analyst coverage, and public debt issuance subsequently. These studies suggest a general improvement in bank credit supply at better rates in the presence of bank competition and financial integration. On the other hand, Jermann and Quadrini (2012) show that financial shocks contributed significantly to the observed dynamics of real and financial variables of firms during the recent financial crisis. Our paper shows that financial frictions in terms of cross-border lending can have a significant effect on the real economy.

Furthermore, our work is related to the research that applies spatial equilibrium modeling techniques and considers economic interactions between heterogenous agents in general. Redding and Sturm (2008) exploits the division of Germany after the Second World War and the reunification of East and West Germany in 1990 as a natural experiment to provide evidence for the importance of market access for economic development. Alessandria, Kaboski, and Midrigan (2013) show that trade wedges can reflect the decisions of importers to change their inventory holdings. They find that a two-country model of international business cycles with an inventory management decision can generate trade flows and wedges consistent with the data. Allen and Arkolakis (2014) develop a general equilibrium framework to determine the spatial distribution of economic activity on any surface with any geography. They provide conditions for the existence, uniqueness, and stability of a spatial economic equilibrium, and then use the framework to estimate the topography of trade costs, productivities and amenities in the United States. They find that geographic location accounts for at least twenty percent of the spatial variation in the U.S. income. Caliendo and Parro (2015) start with a Ricardian model and build into it sectoral linkages, trade in intermediate goods, and sectoral heterogeneity in production. This allows them to quantify the trade and welfare effects from tariff changes due to NAFTA. Fajgelbaum, Morales, Serrato, and Zidar (2015) study the impact of the state tax distribution on aggregate real income, welfare, and the distribution of economic activity across the U.S. states. They build a spatial general-equilibrium model in which
state governments use tax revenue to finance public services, and estimate firm and worker mobility elasticities and preferences for public services. They find that a revenue-neutral tax harmonization leads to a welfare gain of 0.7% and to a similar increase in real GDP. Alessandria, Choi, Kaboski, and Midrigan (2015) study the question of causation between micro volatility and business cycles. They study theoretically the effect of exogenous first- and second-moment shocks to producer-level productivity in a two-country dynamic stochastic general equilibrium model with heterogeneous producers and an endogenous dynamic export participation decision. They empirically find evidence that international reallocation is indeed important for understanding cross-industry variation in cyclical patterns of measured dispersion. Our paper relates to this literature as we quantify the real effects of supply side frictions in bank lending due to financial separation of European countries. We build a spatial equilibrium model to endogenize cross-border bank allocation of capital conditional on country specific productivity and financial frictions.

The rest of the paper is organized as follows. Section 2 describes the economic background in Europe and our datasets. Section 3 introduces the model. Section 4 discusses calibration and model solution technique. Section 5 discusses model estimation results and counterfactual estimates. Section 6 concludes.

2. Financial Integration in Europe

Financial integration worldwide and in Europe in particular was growing for the last three decades before the financial crisis. Cross-border lending between banks in Europe had tripled from approximately two trillion Euros at the beginning of year 2000 (See Figure 1) to approximately six trillion Euros by 2007.

During the financial and sovereign debt crises, financial integration allowed capital to move swiftly across political boundaries in a manner that policy makers found destabilizing. Fears of “sudden stops” similar to earlier crises in Mexico in 1994, and East Asia in 1997 revived previous discussions regarding the costs of financial integration through banking channels (Calvo, 1998; Chang and Velasco, 2001).
Since the crisis, net loans in the European countries returned to positive values only in 2014. Net commercial and industrial loans still remain negative. However, net loans to households have remained flat, indicating that banks are merely replacing redemptions with new loans. Cross-border lending is mainly to the financial sector (interbank loans or loans to other financial institutions). Loans provided by subsidiaries and branches of foreign groups to local households and non-financial corporations are counted as domestic in monetary statistics. Therefore, the data on domestic/cross-border loans fail to capture all the cross-border implications of these loans. In 2014 and 2015 so far, the ECB’s bank lending survey shows that supply and demand for loans have turned a corner. Lending standards (interest rates, collateral and guarantees required, fees and commissions, etc.) moved from net tightening to net easing.

2.1. Banking Regulation and Financial Frictions

Achieving an integrated financial capital market is a core ambition of the European Union. To this end, the European Union has been developing a set of regulatory and prudential rules for financial institutions of member countries. The rules also have an effect outside the EU, as the group works with regulators in the U.S. and other large economies to harmonize supervisory objectives. An important international forum is the Basel Committee on Banking Supervision which sets the standard for the amount of capital banks need to hold to guard against risks faced by banks.

After the financial crisis, the European Commission implemented a series of policy reforms. Cross-border banking regulation overhaul, as a mechanism to ensure financial stability, has received significant attention. (i) Consultations on the reorganization and resolution of credit institutions began immediately in December 2007, which included studying how to ensure transition of assets within a cross-border banking group.\(^5\) (ii) In addition, Basel II and Basel III capital requirements are being phased in since the financial crisis.\(^6\) (iii) Furthermore, in February 2012, the Liikanen commission was established to determine whether, in addition to ongoing regulatory

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\(^6\)See [http://www.bis.org/publ/bcbsca.htm](http://www.bis.org/publ/bcbsca.htm) for details on Basel reforms and regulatory framework chronology.
reforms, structural reforms of the EU banks would strengthen financial stability and improve efficiency and consumer protection, and, if so, to make proposals as appropriate. (iv) Separately, public consultation regarding an EU framework for Cross-Border Crisis Management in the Banking Sector began in October 2009. The commission agreed to avoid reliance on taxpayers to stop financial contagion in the future. The objective of the reform is to create a number of lines of defence against a future financial crisis that include (a) greater prevention and early intervention, (b) better resolution tools and cross-border coordination, and (c) resolution funds.\footnote{See European Commission Communication at \url{http://europa.eu/rapid/press-release_MEMO-10-214_en.htm?locale=en}.}

The resolution fund to finance orderly winding up of banks, a key element of the resolution mechanism, remains at the national level. The commission recognized the importance of setting up a single pan EU fund, but pointed to political frictions that make a pan EU fund or even further, a global fund, infeasible. Needless to say, if countries are expected to set up their own resolution funds for their banks, then a moral hazard problem emerges (Holmstrom, 1982). National policymakers’ support for taking cross-border risk declines. This is because the taxpayers of one country do not wish to insure the banking sector of their country against risks it takes abroad, as they will be fully internalizing the risks in the case of crisis, but not the rewards in the case of prosperity, of such cross-border lending.

In sum, a number of policy initiatives have been adopted to reduce the deleterious effects of future financial contagion. However, they have also increased cross-border financial frictions (Barth, Gerard Caprio, and Levine, 2013; Fernández, Klein, Rebucci, Schindler, and Uribe, 2015). Fernández et al. (2015) create a new dataset of capital control restrictions over the last two decades using the analysis in the Annual Report on Exchange Arrangements and Exchange Restrictions of International Monetary Fund (IMF). Figure 4 reports the overall restrictions index in the 14 European Countries in our sample for which Fernández et al. (2015) (FRU) report their measure. Luxembourg is not in the dataset of Fernández et al. (2015). As can be seen, there has been a significant increase in capital control restriction in recent years. The dataset shows that these re-
restrictions may have started even a bit earlier that the financial crisis. After the financial crisis, these frictions have stayed in place.

2.2. Data

Table 1 reports the relevant statistics of the 15 countries in the European Union that we focus on. These 15 countries were in the European Union before the year 2000. Our sample selection ensures that we have a long enough time series prior to 2007 for each country and thus can calculate the variance and covariance matrix of their joint productivity. The data period covered is from 2000 to 2011. One year after the introduction of Euro in 1999, we consider the year 2000 to be a good starting point. 2011 is the latest year for which data is available from Penn World Tables.

We use the PWT data (Lane and Milesi-Ferretti, 2007) for (i) capital depreciation rate \( \delta \) (“delta” series). (ii) Labor supply \( L \) is the product of the number of persons employed (“emp” series) and the average annual hours worked by the employed person (“avh” series in PWT). (iii) The share of labor compensation in GDP is obtained from “labsh” series in PWT, (iv) the value of capital stock \( K \) is obtained from “ck” series, and (v) output in each country, \( Y \) is the “cgdpo” series. (vi) Investment level \( I \) for each country per year is obtained from “cshi” and “cgdpo” series. (vii) The value of initial capital in country \( i \) is calculated as \( K_{i0} = (K_i - I_i)/(1 - \delta_i) \). (viii) We estimate TFP parameter for each country and each period as the residual in the production function, \( A_i = Y_i / (K_i^{\alpha_i} L_i^{1-\alpha_i}) \). We normalize \( Y_i \) and \( L_i \) in 2005 in the Great Britain in our sample to 1. (ix) Savings \( S \) is the sum of current account and investment. The table reports significant differences in the reported characteristics. The relative prosperity and productivity, with respect to the U.S., also varies significantly. These data will help us calibrate the model described in the next section.

Table 2 reports the cross-country variance-covariance matrix of logarithm of TFP levels in the 15 European countries for the full sample period. It is notable that there is substantial variation in the variance of logarithm of TFP levels across nations. Denmark, has one of the lowest levels at 1.47 percentage points standard deviation, whereas Luxembourg which is an active conduit for allocation of capital within Europe has the highest reported level at 13.71 percentage points.
standard deviation. The German standard deviation of logarithm TFP is almost half of that of France, at 3.87 percentage points standard deviation. The TFPs in most economies are positively correlated, which is expected, with the only exception being Portugal and Denmark. Among the larger economies, the German TFP is more correlated with that of Great Britain (0.70) than of France (0.35). The TFPs of Italy and Spain are even less correlated with that of Germany, having correlations of 0.21 and 0.23 respectively.

Table 3 reports the cross-border claims outstanding against each country as a fraction of total claims outstanding by resident banks of the respective country. Data from BIS is used to calculate cross-border lending. The table shows significant variation in cross-border lending across countries and shows a significant decline worldwide after the crisis. As discussed earlier, while major economies such as the U.S. can withstand this financial separation more easily due to a very large domestic lending market – indeed cross-border lending had only risen to 16.5% in the U.S. and has now fallen to 11.9% – this is a larger concern for the European economies where trade and labor markets remain integrated but financial markets face significant fragmentation post crisis.

### 2.3. Europe as (an almost) Closed Economy

As we will discuss in Section 3, we consider general equilibrium in terms of capital allocation within the 15 European countries. A natural question is whether the assumption that Europe is a closed economy is too strong. Figure 5 plots current account as a fraction of output of Germany and the remaining European countries in our dataset for the sample period 2000-2011. Data are obtained from Lane and Milesi-Ferretti (2007), which provides data on foreign assets and foreign liabilities for a large sample of countries for the period 1970-2011.

The left panel shows that current account as a fraction of GDP for our set of countries is on average approximately 0.5 percentage points. The second panel shows that there is a strong negative correlation between the current account of Germany and the remaining 14 countries, suggesting that capital is getting mostly allocated within the sample of countries. These observations provide confidence in our model’s assumption where countries allocate capital only within the set of 15 European countries. To be additionally conservative, in our counterfactual experiments, we will
exclude Great Britain and Ireland, whose economies are more connected across the Atlantic Ocean with the U.S. and the Commonwealth nations even though we estimate the model with all 15 countries. This will ensure that we capture impact of financial frictions in Continental Europe and not financial frictions that, say, affect capital flow to Great Britain and Ireland from the U.S.

2.4. Tradeoff regarding Financial Integration

Financial markets over the last few decades have become highly interconnected at the global level. Regional interconnections also have increased substantially, specifically in Europe, especially after the introduction of Euro. The financial crisis provided the counterpoint to the benefits of financial integration: the possibility of financial contagion leading to a “doom loop” (See Farhi and Tirole, 2014, among others).

In response to the crisis, central banks and policymakers worldwide first stabilized the financial system and since then have focused their attention on ensuring that systemically important banks are better capitalized and have a clear recovery and resolution plan. In addition, the European Systemic Risk Board (ESRB) has been entrusted with a macro-prudential oversight function in Europe. The corresponding institution in the U.S. is the Financial Stability Oversight Council.

This paper does not focus on the costs to the economy due to possible systemic risk, but focuses on the costs to the economy from lesser financial integration. Answering the question of whether such costs are justified by the potential gains from avoiding future contagion, is beyond the scope of this paper. The question, however, is an important tradeoff that policymakers must consider (See Stein, 2009, for a discussion of benefits and costs of capital regulation on market efficiency).

3. The Model

The main problem of interest is allocation of capital across countries by banks. This section first discusses the representative household and the representative firm. We then introduce the bank’s problem and define the equilibrium.
3.1. Household

There are $N$ countries in the economy. At the beginning of a period, representative households in country $i \in \{1, \ldots, N\}$ have $s_i$ units of savings. They deposit the savings in the bank of their country, for which they receive interest $r_i$ per unit savings at the end of the period. Households also supply one unit of labor inelastically at wage $w_i$. The amount of savings $s_i$ and prevailing wage $w_i$ varies by country $i$. The number of households $L_i$ in each country is also allowed to be different to capture heterogeneity in sizes of European countries.

At the end of the period, households of country $i$ consume the return $r_i$ from their bank deposits $s_i$ and their wages $w_i$. Households’ consumption $c_i$ is given as follows:

$$c_i = w_i + r_i s_i.$$  \hspace{1cm} (1)

The assumption of no new savings allows us to keep the household problem static. Since we are interested in a relatively short period of time, and since the model solution has a large dimensionality from the number of countries in the EU countries, we believe tractability justifies this assumption.

3.2. Bank’s Problem and Financial Integration

In this model, the representative households of each country simply deposit their savings in the domestic bank of their own countries. We assume that the bank in country $i$ is owned by the households of the same country. The bank/financial institution then allocates the capital across the countries to maximize the utility of their owners (Diamond, 1984).

Let $R_{ij}$ denote the gross investment returns a bank in country $i$ obtains when investing in country $j$ and let $\phi_{ij}$ be the share of assets of a bank in country $i$ investing in country $j$. We impose the no-short-selling constraint that requires all $\phi_{ij}$ to remain non-negative, $\phi_{ij} \geq 0$. The bank’s problem in country $i$ is to maximize the expected utility of the representative household, subject to the budget constraint (Equation 1), constraint that allocation fractions across the countries add up to unity,
and to the no short sale constraint. Thus, the bank’s problem is characterized as follows:

\[
\begin{align*}
\text{max}_{\Phi_i \equiv \{\phi_{i1}, \ldots, \phi_{iN}\}} & \quad E_t u(c_{i,t+1}) \\
\text{s.t.} & \quad c_{i,t+1} = w_{i,t+1} + \Phi'_i R_{i,s_i}, \\
& \quad \phi_{ii} + \sum_{j \neq i} \phi_{ij} = 1, \\
& \quad \phi_{ij} \geq 0, \quad \forall i, j.
\end{align*}
\]

where \(\Phi_i = \{\phi_{i1}, \ldots, \phi_{iN}\}\) is the vector of portfolio allocation and \(R_i = \{R_{i1}, \ldots, R_{iN}\}\) is vector of returns. Thus, the final return of the household on total savings is \(r_i = \Phi'_i R_i\). We assume that the household utility function is CRRA:

\[
u(c) = \frac{c^{1-\gamma}}{1-\gamma}
\]

where \(\gamma\) is the risk aversion coefficient of the household.

Returns on domestic investment in country \(i\), \(R_{ii}\), are endogenously determined based on supply of capital \(K_i\), labor force available \(L_i\), productivity \(A_i\) and wages \(w_i\) (Equation 3 discussed next in the firm’s problem). The bank’s cross-border returns \(R_{ij}\) depend on country \(j\)’s domestic investment return \(R_{jj}\) and the level of financial integration of country \(j\). As in Gertler and Kiyotaki (2010); Gertler, Kiyotaki, and Queralto (2012), banks invest in firms by purchasing productive capital.

Financial frictions due to limited financial integration are captured by parameter \(\theta_i\) that varies across countries. The rate of cross-border investment return in country \(j\) for banks in country \(i\) depends upon country \(j\)’s level of financial integration:

\[
R_{ij} = R_{jj} e^{-\theta_j}, \quad \forall i, j.
\]

where the investment rate \(R_{jj}\) for each country \(j\) is endogenously determined based on demand of capital from firms in the country and supply of capital from households who can choose among countries. In effect, there is a “haircut” on return due to levels of financial integration of each
country. When country \( j \) is fully financially integrated with the rest of countries, \( \theta_j = 0 \); and when country \( j \)’s capital market is completely isolated from the rest of the economies (i.e., \( \theta_j \to \infty \)), investors can not earn any return from their investment in country \( i \), i.e. \( R_{ij} = 0 \). Our specification of financial frictions (Equation 2) enables one to extend our work and investigate a counterfactual scenario where there is a large negative shock (either temporary or permanent) to country \( j \)’s financial integration level \( \theta_j \).

3.3. Firm’s Problem

The representative firm in country \( i \) enjoys productivity \( A_i \) and faces local wage \( w_i \) and capital rental rate \( R_{fi} \). The firm is assumed to have Cobb-Douglas production function, and maximizes profits \( \pi_i \) by choosing rented capital \( K_i \) as follows:

\[
\pi_i = \max_{K_i} A_i K_i^\alpha_i L_i^{1-\alpha_i} - w_i L_i - R_{fi} K_i
\]

where \( A_i \) is the aggregate productivity shock in country \( i \) and \( \alpha_i \) is the output elasticity of capital.

Let \( A = \{A_i, \ldots, A_N\} \) be the vector of productivity shocks for all N countries. We assume that \( A \) follows a multivariate log normal distribution as follows:

\[ A \sim \ln N(\mu, \Omega). \]

Here we allow the the productivity shocks between different countries to be correlated with each other. This correlation can create cross-country linkages of financial returns based on the real economy. In particular, if \( \text{cov}(A_i, A_j) \neq 0 \), the productivity shocks between countries \( i \) and \( j \) are correlated. Thus, the representative bank in country \( i \) may have an incentive to invest in country \( j \)’s production in order to reduce the risk of the portfolio of a household in country \( i \).

The rate of return for the bank that rents capital in country \( i \) is:

\[ R_{ii} = 1 + R_{fi} - \delta_i \]
where $\delta_i$ is the capital depreciation rate in country $i$.

### 3.4. Equilibrium

We consider an equilibrium where a representative bank in country $i$ makes the allocation decision regarding the share of domestic and foreign investment. Given the level of financial integration vector $\{\theta_i | i \in [1, N]\}$, and similarly productivity shocks $\{A_i\}$, deposits per capita $\{s_i\}$ and population size $\{L_i\}$, the equilibrium consists of a cross-country distribution of banks’ asset allocation decisions, capital returns and firms’ capital levels $\{\phi_{i1}^*, \ldots, \phi_{iN}^*, R_{ii}^*, K_i^*\}$ and is defined as follows:

1. $\{\phi_{ii}^*, \{\phi_{ij}^*\}_{j \neq i}\}$ solve banks’ optimization problem as follows:

$$\max_{\Phi_i = \{\phi_{i1}, \ldots, \phi_{iN}\} \geq 0} E_t u(c_{it+1})$$

s.t. $c_{it+1} = w_{it+1} + \Phi_i R_i s_i$,

$$\phi_{ii} + \sum_{j \neq i} \phi_{ij} = 1$$

2. $\phi_{ii}^* s_i L_i + \sum_{j \neq i} \phi_{ij}^* s_j L_j + K_{i0}(1 - \delta_i) = K_i^*$ for every country $i$.

3. $w_i^* = (1 - \alpha_i)A_i(K_i^*)^{\alpha_i} L_i^{-\alpha_i}$ for every country $i$.

4. $R_{ii}^* = 1 + \alpha_i A_i(K_i^*)^{\alpha_i - 1} L_i^{1-\alpha_i} - \delta_i$ for every country $i$.

5. $R_{ij}^* = R_{jj}^* e^{-\theta_j}$ for every country.

Presently, the incentives of the bank of country $i$ in the model are aligned with those of the households of the same country. In future work, we plan to extend the model to allow a wedge between households and banks, specifically due to macro-prudential restrictions at the bank level. However, for the results in this paper, distinctions between the objectives of the bank and household are assumed away.
4. Calibration

This section describes calibration details and equilibrium solution approach. To calibrate the model, as discussed in Section 2, we use the data from the Penn World Tables, the Bank of International Settlements and Lane and Milesi-Ferretti (2007). The original dataset in Lane and Milesi-Ferretti (2007) was extended to include the data up to 2011 by Lane and Milesi-Ferretti.

4.1. Financial Integration, Productivity and Demographic Parameters

Using the data from the PWT, we calibrate the parameters of the countries’ production functions. To calibrate the production function parameters for each country \(i\), we use the data on (i) output \(Y\), (ii) labor \(L\), (iii) productivity shocks \(A\), (iv) output elasticity of capital \(\alpha\), and (v) rented capital \(K\).

We use the series “cgdpo” from the PWT to measure output in each country, \(Y_i\). We compute \(L_i\) as the product of the number of persons employed (“emp” series in PWT) and the average annual hours worked by the employed person (“avh” series in PWT). To obtain the values for \(\alpha_i\), we use the data on the share of labor compensation in GDP (“labsh” series in PWT).

As discussed in Section 3, the final rented capital observed in a country is the sum of initial capital available to the country and the sum of investments made by the resident banks of all 15 European countries out of their savings. The resident banks of each country in turn make those investments based on return-risk tradeoff where return on capital is endogenously determined based on production function parameters of the target country and investments by other representative banks of the other countries. Hence, we use the PWT data to measure the value of capital stock \(K_i\) (“ck” series), investment \(I_i\) (“csh_i” and “cgdpo” series) and capital depreciation rate \(\delta_i\) (“delta” series). Using this data, we set the value of initial capital in country \(i\) to \(K_{i0} = (K_{i} - I_{i})/(1 - \delta_{i})\).

We normalize \(Y_i\) and \(L_i\) in 2005 in one of the countries in our sample to 1. We choose the output and labor supply of Great Britain in the year 2005 for the purpose of normalization of output and labor of the remaining 14 European countries.

Having a measure of output \(Y_i\), measures of production inputs \(L_i\) and \(K_i\), and the production function parameter \(\alpha_i\), we estimate TFP parameter for each country and each period as the residual in the production function, \(A_i = Y_i/ \left(K_i^{\alpha_i}L_i^{1-\alpha_i}\right)\). We also calibrate our parameters using an alterna-
tive approach, that we discuss in Section 5. In the alternative approach, we take TFP as given and calculate the output for each country $Y_i$. The results remain quantitatively and qualitatively similar in that case as well.

The final parameter of interest is savings $s_i$ in country $i$. This is the capital that banks allocate across the European union. We set the amount of savings in country $i$, equal to the sum of investment and current account. As mentioned before, current account data is obtained from Lane and Milesi-Ferretti (2007). We average all parameters of interest over the corresponding subperiods (2000-2007 and 2008-2011). Table 1 summarizes our estimates of the parameter values for the two subperiods that we are interested in, 2000-2007 and 2008-2011. Table 2 gives our estimates of the variance-covariance matrix for log($A_i$), using the data from the whole 2000-2011 period. Section 2 discusses the data in more detail.

The parameter that captures financial frictions between countries is the level of financial integration $\theta_i$. Financial integration parameters are calibrated using our structural model by matching the observed data moments on cross-border lending for each country with the model predicted corresponding moments. Table 3 reports for each country and each year the gross cross-border lending that the country receives and claims outstanding in a certain year as a fraction of the sum of total claims outstanding in terms of lending by domestic banks and gross cross-border lending. Data used to calculate the fractions are obtained from the BIS. Section 2 discusses the table in more detail.

4.2. Equilibrium Solution Algorithm

The optimal allocation of capital for each country is dependent on the optimal allocation of capital of all other $N-1$ countries, where $N = 15$ countries in our case. This is because the return on investment is dependent on total capital invested, which is dependent on allocation of other countries. In other words, every country is allocating across $N$ countries based on a $N \times N$ variance covariance matrix of productivity shocks, and based on the $N \times 1$ return vector for each country which is dependent on allocation of capital of other countries into the target country and the haircut faced by each country in investing in the target country.
Given the model parameters, we find the equilibrium of the model by solving the system of equilibrium conditions that consist of the first-order optimality conditions for the banks and market-clearing conditions:

\[ s_i E u'(c_i)(R_{ij} - R_{iN}) + \lambda_{ij} - \lambda_{iN} = 0, \quad \forall i, j, \]

\[ \lambda_{ij} \phi_{ij} = 0, \quad \lambda_{ij} \geq 0, \quad \phi_{ij} \geq 0, \quad \forall i, j, \]

\[ c_i = w_i + \Phi_i R_i s_i, \quad \forall i, \]

\[ \phi_{ii} + \sum_{j \neq i} \phi_{ij} = 1, \quad \forall i, \]

\[ \phi^*_i s_i L_i + \sum_{j \neq i} \phi^*_j s_j L_j + K_{i0}(1 - \delta_i) = K^*_i, \quad \forall i, \]

\[ w^*_i = (1 - \alpha_i)A_i(K^*_i)^{\alpha_i} L_i^{-\alpha_i}, \quad \forall i, \]

\[ R^*_ii = 1 + \alpha_i A_i(K^*_i)^{\alpha_i-1} L_i^{1-\alpha_i} - \delta_i, \quad \forall i, \]

\[ R^*_ij = R^*_jj e^{-\theta_j}, \quad \forall i, j. \]

This system includes the budget constraints and market clearing conditions from section 3.4, and the first-order conditions that describe the solution to the investment allocation problem of the representative banks. Because of the presence of the short-selling constraints (we allow representative banks to take only non-negative positions in member countries), these first-order conditions take the form of the Kuhn-Tucker inequalities, with \( \lambda_{ij} \) denoting the corresponding Kuhn-Tucker multipliers. We use Zangwill and Garcia (1981) approach to replace the Kuhn-Tucker inequalities with equations by an appropriate change of variables, and solve the resulting system of non-linear equations, given the values of \( \theta_j \).

Given the high dimensionality of the problem, we use monomial integration rules which were introduced by Judd (1998) to economics literature, and described in detail in Maliar and Maliar (2014). Monomial integration rules construct a relatively small set of nodes distributed within a multidimensional hypercube. The computational expense of monomial rules grows polynomially with the dimensionality of the problem, which makes them ideal for problems of large dimensions.
such as the present one.

The equilibrium solution output is a matrix of allocation of capital by all countries in all other countries conditional on certain haircuts. The estimation of these financial frictions is discussed in the next section.

4.3. Estimation Approach

To reduce the dimensionality of the problem, and to have an exact match in terms of moments, we keep the haircuts $e^{-\theta_i}$ equal for a target country irrespective of which country is investing into it. For example, the haircut faced by a German bank and a French bank on their investments in Greece is the same.

To estimate the $N \times 1$ vector of financial frictions that provide an optimal $N \times N$ allocation of capital that allows us to match data moments, we utilize a fully parallelizable global optimization algorithm as suggested in Guvenen (2011). The algorithm combines a global search stage with a local stage, as is customary. The algorithm uses the Sobol sequence to obtain a series of “quasi-random” starting points for the global search stage. Then it conducts a local search from that starting point using the Nelder-Mead’s downhill simplex algorithm. The Sobol’ sequence provides a way to search thoroughly and at the same time, efficiently across the parameter space of frictions. The algorithm can be easily parallelized by allowing each central processing unit core to do a separate local search.

The first column of Table 4 reports the relative estimated financial frictions $e^{-\theta_i}$ after the financial crisis using our model and data. As discussed before in Section 2, we calculate the cross-border claims outstanding against each country as a fraction of total claims outstanding by resident banks of the respective country. Data is obtained from BIS. The average values for the period 2008–2011 are reported in the “Data” column of Foreign Shares panel.

We note that the data moments regarding foreign share of total investment is well matched by the model generated moments. On average, the model tracks foreign investment shares in the data within 0.68%. The reported distance is calculated as a sample standard deviation. As an out of sample test, we also tabulate the model generated aggregate investment level in a country and the
data on investment obtained from PWT. The match is reasonably good in this case.

To test the external validity of the estimated financial frictions, we utilize an index of overall restrictions created by Fernández et al. (2015). As mentioned before, using the Annual Report on Exchange Arrangements and Exchange Restrictions by IMF, Fernández et al. (2015) creates a dataset of capital control restrictions on both the inflows and outflows of 10 categories of assets for 100 countries over the period of 1995–2013. We find that, for the post-crisis sample period of 2008-2011 in continental Europe, the cross-sectional correlation between the overall restrictions index and our estimated financial frictions is 22.9 percent. Figure 6 reports the correlations. The two vectors are demeaned before calculating correlation to avoid spurious correlation. Luxembourg is not in the dataset of Fernández et al. (2015), and hence is excluded in the reported correlation. We also exclude Portugal which has a very high capital control index number compared to Spain, even though our estimates suggest Spain and Portugal are similar in terms of capital control. GDP weighted cross-sectional correlation estimate is 78.7 percentage points, as shown in the right panel of Figure 6. This suggests that our estimates of financial frictions are a satisfactory match for larger European nations.

As we see, the variation in haircuts on investment returns are not very large. This shows the significant importance of financial frictions, which with such limited variation is able to generate large effects on output, as Section 5 shows next. It is important to note that cross-sectional variation is important for allocation of capital within period, but at the same time change in financial frictions from the pre-crisis period is important for determining overall impact of financial frictions on the economy. The next section estimates the impact of change in financial frictions on the economy.

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8As discussed earlier, we exclude the Great Britain and Ireland in the counterfactuals in the next section, and hence we exclude them in the external validity test as well. This is even though we estimate the model with all 15 countries. This approach ensures that we capture impact of financial frictions in continental Europe and not financial frictions that affect capital flow to Great Britain and Ireland from, say, the U.S., as the two island nations are relatively more connected to the U.S. and the Commonwealth nations.
5. Results

We conduct two counterfactual experiments to measure the benefits of reduction in supply side frictions due to financial integration.

5.1. Impact of Financial Disintegration on European Recovery

We calibrate the model parameters separately for the time period before the financial crisis (2000 to 2007) and the time period after the financial crisis (2008 to 2015). These two sets of calibration exercises yield two sets of parameters that govern the degree of financial integration ($\Theta^{pre \ 2007}$, $\Theta^{post \ 2007}$) conditional on the real side of the economy before and after the financial crisis, where $\Theta$ represents the vector of financial frictions for the European economies.

In order to quantify the effects of financial integration on outcomes and capital investment, we compare the pre financial crisis world with a counterfactual world where the financial integration level is that of the post crisis level $\Theta^{post \ 2007}$ and the real side of the economy remained at the pre-crisis level $\{\alpha^{pre \ 2007}, A^{pre \ 2007}, \delta^{pre \ 2007}, L^{pre \ 2007}, S^{pre \ 2007}, K_0^{pre \ 2007}\}$. The difference in outputs between these two scenarios measures the real effects of changes in financial integration. The reason we conduct this counterfactual as opposed to the opposite where we take estimated financial frictions from the pre 2007 period and use the data from the post 2007 period is because significant economic and regulatory interventions were conducted post financial crisis. The pre 2007 period data is relatively more undisturbed. Further, we are interested in financial frictions from the post 2007 period, some of which have been imposed by regulatory authorities themselves through “ring fencing” of economies. Hence, applying net frictions estimated from the post-crisis period on the undisturbed pre-crisis period economic data is the appropriate exercise in our opinion.

Panel A of Table 5 reports the results. The first counterfactual reports the output (Y), wage (W) and return on capital (R) for continental European economies if they faced the same financial frictions as before the financial crisis. The financial frictions have been estimated using the model and data from the post financial crisis period as described in Section 4. The results reported are scaled versions of the same characteristics for each country in the pre-crisis period.
We focus on continental Europe in the counterfactuals because the United Kingdom is a major financial center and Ireland has been going through structural changes over the last decade. Further, the two English speaking island nations are relatively more connected to the U.S. and the Commonwealth nations. Therefore, capital from around the world flew into these countries before the crisis, and left after the crisis. This is not the case in continental Europe which is more or less a closed economy (See discussion in Section 2).

Overall, Panel A of Table 5 shows that if financial frictions post-crisis existed in the pre-crisis period, all else being equal, the GDP of continental European countries will be 0.54 percentage points lower. This estimate is in line with other estimates of the impact on GDP of banking sector overhaul (See, for example Slovik and Courède, 2011, who estimate that the impact of Basel III on GDP growth is between -0.05 to -0.15 percentage point). All else being equal includes pre-2007 levels of depreciation rate, labor, TFP, output elasticity of capital, initial capital available to each country, and investable savings (See Panel A of Table 1). In addition, labor wages would have been 0.78 percentage lower across continental Europe before the financial crisis if the same level of financial frictions as those estimated post-financial crisis existed. The marginal product of capital would also have been 0.76 percent lower.

To put this reduction in output in the context of output gap, we estimate output gap in a simple manner. As mentioned before, output gap refers to the deviation of output from the long run growth path in the years after the crisis. Table 6, which shows that the average GDP growth rate for the post-crisis period (2008–2011) is effectively zero. It also shows that the growth rate of the continental European Union countries has been approximately 2.39% percentage points per year for the two decade period of 1991–2011. Thus, we take the output gap to be the difference, which is 2.39% in this case. Our output gap number is in line with other estimates (See International

Note that in our model, we abstract from economic growth. Hence, we need to de-trend the data before comparing it with the results in our model. If we use our estimate of the long-run growth rate (2.39%) for de-trending, and let $y_{pre}$ and $y_{post}$ denote the output before and after the financial crisis, we get that the output gap is $(y_{post}/1.0239 - y_{pre})/y_{pre} = (y_{pre}/1.0239 - y_{pre})/y_{pre} = -2.33\%$. Note that $y_{post} = y_{pre}$ since the realized economic growth was close to 0 during the post-crisis period. This number is slightly smaller than our denominator in reported results. Hence, our reported contribution of financial frictions is more conservative.
Monetary Fund, 2013, for example). Thus, we find that the impact of financial disintegration on the European economy is 22.6% percent of the output gap.

Focusing on individual countries, the GDP of Germany, which is 27 percentage of the continental European economy in our data period, would have been 1.02 percentage lower. France, with 19 percent of the continental European economy, would have suffered a 0.25 percentage lower output. Greece, a country that faced significant uncertainty post financial crisis regarding its future in Europe, would have suffered a 0.63 percentage lower output if similar financial constraints existed before the crisis. However, the aggregate results are GDP weighted, and thus are not driven by Greece, which is only 2.6 percent of the European output in our sample.

5.2. Benefits of an Integrated Financial System

In this counterfactual simulation analysis, we evaluate the effects of a fully integrated financial system by comparing the calibrated model economies with a counterfactual scenario where all countries are fully integrated financially. We implement this counterfactual simulation by setting \( \theta_i = 0 \) for every country \( i \in \{1, \ldots, N\} \). When \( \theta_i = 0 \), country \( i \) is fully integrated with the rest of the Euro countries. In other words, there are no haircuts due to financial frictions \( \theta \) on investment returns for any bank residing in any country, irrespective of the investment being domestic or foreign. The difference in outputs between an integrated Europe with \( \theta_i = 0 \) and the present Europe provides an estimate of the gains from integrative policies.

Panel B of Table 5 reports the results of the counterfactual economy where there are no haircuts for cross-border investment. The panel shows that if financial frictions could be eliminated in the pre-crisis period, all else being equal, the GDP of continental European countries would have been 0.37 percentage points higher. Given that the growth rate of European Union since 1991 until 2011 has been at 2.39%, this counterfactual suggests that the complete removal of the financial frictions would lead to an additional growth equal to 15.4% percent of the long-run growth rate. As before, all else being equal includes pre 2007 levels of depreciation rate, labor, TFP, output elasticity of capital, initial capital available to each country, and investable savings (See Panel A of Table 1). In addition, labor wages would have been 0.26 percentage higher across continental Europe before
the financial crisis in an economy with a completely integrated financial system. The marginal product of capital would also be higher by 0.23 percent.

In contrast to the case when post-crisis financial frictions have hurt Germany, which is the largest economy in continental Europe, if financial frictions are eliminated, we find that Germany per se is not a major beneficiary (it gains 0.03 percentage point in output). However, French output increases by 0.77 percentage point, and Spanish economic output increases by 90 basis points. The Greek economy still suffers a loss of 16 basis points.

5.3. Robustness Tests

In an alternative approach to calibration, in place of estimating TFP parameter for each country as a residual in the production function, we download productivity data from the Penn World Tables. Data for the U.S., total factor productivity at constant national prices, is available as “rtfp”, which normalizes $A_{US} = 1$ for 2005. Data for other countries is available as “ctfp” relative to the U.S. that year. We obtain the values for $A_i$ for each country as the product of these two series. Using this data, we calculate outputs which are somewhat different from the output provided in the data. We then estimate financial frictions, and use estimated frictions to conduct the counterfactual experiments.

Table 7 shows that results remain similar: if financial frictions post-crisis existed in the pre-crisis period, we find that the growth rate of the continental European economy would be 0.47 basis points lower, which is approximately 19.7 percent of the average growth rate of the European Union during 1991-2011. Further, Panel B shows that if financial frictions could be eliminated in the pre-crisis period, the GDP of continental European countries would have been 36.8 basis points higher.

Overall, our results show that additional gains for the European economy can be obtained over and beyond restoration of financial flow to the levels before the crisis. Our work does not take into account the costs of financial integration which include systemic risk experienced during the financial crisis. We just want to underscore the benefits of financial integration in this work, so that policymakers can make the appropriate tradeoff.
6. Conclusion

The European experiment of political and economic integration is unparalleled. The financial crisis, the resulting worldwide tremors, the sovereign debt crises across Europe and various geopolitical problems have created significant challenges for the European policymakers.

This paper seeks to highlight the benefits of financial integration that Europe enjoyed before the crisis, and the costs of financial segmentation since then. Our analysis shows that financial segmentation can explain about 22.6% of the output gap since the crisis. In contrast, if financial frictions are reduced, even beyond what existed before the financial crisis, we find that European growth rate could increase by an additional fifth of its long term growth rate. Thus, we argue that while financial separation is useful to limit contagion during a crisis, such ringfencing comes at certain costs borne by firms and consumers at other times.

Two important limitations of our work are worth mentioning. First, we employ a static model which does not take into account the relative dynamics of the European economies beyond the productivity inter-relationships that we consider. While a static model may be sufficient for our purposes in this work, it may not be sufficient for future work which may consider, say, long term equilibrium implications of variation in financial frictions across countries. We also do not consider systemic risk in this model, because other researchers have investigated it very carefully.

The policymakers face a tradeoff. Hopefully, our work will help them and the European Union in general on their path to a greater, stronger and prosperous union.
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Figure 1: Cross-border Bank Lending and Commercial and Industrial Lending around the Crisis

Note: The left panel reports the cross-border claims outstanding against the respective economies. Data are obtained from BIS. The right panel reports business loans in EU countries and in the U.S. normalized to 100 in the year 2006. Data is obtained from ECB and the U.S. Federal Reserve.
Figure 2: Cross-border Bank Lending over time

Note: The figure reports the incoming cross-border claims outstanding against each country as a fraction of total claims outstanding by resident banks of the respective country in the respective years and the incoming cross-border claims outstanding. Data from BIS is used to calculate cross-border lending.
Figure 3: Cross-border Bank Lending before the crisis (2007) and recently (2014)

Note: The figure reports the incoming cross-border claims outstanding against each country as a fraction of total claims outstanding by resident banks of the respective country in the respective years and the incoming cross-border claims outstanding. Data from BIS is used to calculate cross-border lending. Cross-border lending data on Israel, Norway, Russia, and Turkey are for reference only. Those nations are not part of the 15 EU countries analysed in this paper.
Figure 4: Capital Control Restrictions and output growth rates in European Economies

Note: Using the Annual Report on Exchange Arrangements and Exchange Restrictions by IMF, Fernández et al. (2015) creates a dataset of capital control restrictions on both inflow and outflows of 10 categories of assets for 100 countries over the period of 1995–2013. The figure reports the overall restrictions index over the last 20 years in the 14 European Countries in our sample for which Fernández et al. (2015) (FRU) report their measure. Luxembourg is not in the dataset of Fernández et al. (2015). The second panel reports the output growth rates for the Continental EU countries for the two decade period of 1991–2011.
Figure 5: Current Account of European Economies

Note: The figure plots current account as a fraction of output of Germany and the remaining European countries in our dataset for the sample period 2000-2011. Data are obtained from Lane and Milesi-Ferretti (2007).
Figure 6: Current Account of European Economies

Note: The figure tests the external validity of the estimated financial frictions, with respect to an index of overall restrictions created by Fernández et al. (2015) (FRU). Using the Annual Report on Exchange Arrangements and Exchange Restrictions by IMF, Fernández et al. (2015) creates a dataset of capital control restrictions on both inflow and outflows of 10 categories of assets for 100 countries over the period of 1995–2013. We find that, for the post-crisis sample period of 2008-2011 in continental Europe, the cross-sectional correlation between the overall restrictions index and our estimated financial frictions is 22.9 percent (left panel). The two vectors are demeaned before calculating correlation to avoid spurious correlation. Luxembourg is not in the dataset of Fernández et al. (2015), and hence is excluded in the reported correlation. We also exclude Portugal which has a very high capital control index number compared to Spain, even though our estimates suggest Spain and Portugal are similar in terms of capital control. The right panel shows that GDP weighted cross-sectional correlation estimate is 78.7 percentage points.
Table 1: Summary Statistics of 15 EU Countries

Note: The set of countries are those that joined the European Union by 1 January 1995. The next set of countries joined on 1st May 2004. Our sample selection ensures that we have long enough time series observations prior to 2007 for each country and thus can calculate the variance and covariance matrix of their joint productivity. Data period is from 2000 to 2011. One year after the introduction of Euro in 1999, we consider the year 2000 to be a good starting point. This is because 2011 is the latest year for which data is available from Penn World Tables (PWT) (Lane and Milesi-Ferretti, 2007). (i) Capital depreciation rate $\delta$ is the “delta” series from PWT. (ii) Labor supply $L$ is the product of the number of persons employed (“emp” series) and the average annual hours worked by the employed person (“avh” series in PWT). (iii) The share of labor compensation $\alpha$ in GDP is obtained from “labsh” series in PWT, (iv) the value of capital stock $K$ is obtained from “ck” series, and (v) output in each country, $Y$ is the “cgdpo” series. (vi) Investment level $I$ for each country per year is obtained from “csh” and “cgdpo” series. (vii) The value of initial capital in country $i$ is calculated as $K_i^0 = (K_i - I_i)/(1 - \delta_i)$. (viii) We estimate TFP parameter for each country and each period as the residual in the production function, $A_i = Y_i/(K_i^\alpha_i L_i^{1-\alpha_i})$. (ix) Savings, $S$, is the sum of current account and investment. The table reports significant differences in the reported characteristics. The relative prosperity and productivity, with respect to the U.S., also varies significantly.

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Table 2: Variance-covariance for log(TFP)

Note: This table reports the variance-covariance matrix of logarithm of Total Factor Productivity for the 15 EU countries in the sample for the whole sample period 2000–2011. Reported numbers are scaled as follows for readability: $\sigma_{ij} \times 10^3$.

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Table 3: Cross-border Lending: 15 European Union Countries

Note: This table reports the cross-border claims outstanding against each country as a fraction of total claims outstanding by resident banks of the respective country. Data for 2015 are for Q1. Data from BIS is used to calculate cross-border lending.

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Table 4: Calibration of Financial Integration Haircuts

Note: This table reports estimation of financial frictions obtained using post financial crisis data and the model in the paper. The estimation of friction is using moments on foreign share of lending. The aggregate investment moments are reported to show out of sample validity. Discounts are reported relative to the minimum discount estimated (Portugal), where numbers reported are $e^{-\theta}$.

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</tr>
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<td>0.3803</td>
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</tr>
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<td>0.3836</td>
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<tr>
<td>PRT</td>
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</tr>
<tr>
<td>SWE</td>
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<td>0.5013</td>
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</table>

| model-data | 0.00677 |
Table 5: Counterfactuals: European Economy without Financial (dis)integration

Note: This table reports the two counterfactuals conducted. The first counterfactual reports the output (Y), wage (W) and return on capital (R) for continental European economies if they faced the same financial frictions before the financial crisis. The financial frictions have been estimated using the model and data from the post financial crisis period. The second counterfactual reports the same economic characteristics in case the European economy faced no financial frictions.

<table>
<thead>
<tr>
<th></th>
<th>Panel A: Post-crisis frictions</th>
<th>Panel B: No fin. frictions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Y</td>
<td>W</td>
</tr>
<tr>
<td>AUT</td>
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</tr>
<tr>
<td>BEL</td>
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</tr>
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<td>DEU</td>
<td>0.9898</td>
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</tr>
<tr>
<td>DNK</td>
<td>0.9968</td>
<td>0.9963</td>
</tr>
<tr>
<td>ESP</td>
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<td>1.0018</td>
</tr>
<tr>
<td>FIN</td>
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<td>0.9976</td>
</tr>
<tr>
<td>FRA</td>
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<td>0.9937</td>
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<tr>
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<td>1.0000</td>
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<td>LUX</td>
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<tr>
<td>NLD</td>
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<td>0.9901</td>
</tr>
<tr>
<td>PRT</td>
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</tr>
<tr>
<td>SWE</td>
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<td>0.9839</td>
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<tr>
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<tr>
<td>Fraction of Output Gap</td>
<td>0.2255</td>
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</table>
Table 6: European Economy Average Output Growth Rates

Note: This table reports the average output growth rates in the Continental EU economies during the sample period using Penn World Tables data.

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<thead>
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<td>0.0275</td>
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<td>0.0237</td>
</tr>
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<td>0.0044</td>
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<td>ESP</td>
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<tr>
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<td>0.0224</td>
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<td>0.0211</td>
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<tr>
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<td>-0.0134</td>
<td>0.0272</td>
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<td>-0.0037</td>
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<td>0.0313</td>
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<td>0.0267</td>
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<td>0.0244</td>
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<td>GDP Weighted avg.</td>
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<td>-0.029e-5</td>
<td>0.0239</td>
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</table>
Table 7: Alternative Calibration and Counterfactuals: European Economy without Financial (dis)integration

Note: This table reports the two counterfactuals conducted using an alternative approach regarding calibration, where TFP data directly downloaded from Penn World Tables is used rather than estimating it. The first counterfactual reports the output (Y), wage (W) and return on capital (R) for continental European economies if they faced the same financial frictions before the financial crisis. The financial frictions have been estimated using the model and data from the post financial crisis period. The second counterfactual reports the same economic characteristics in case the European economy faced no financial frictions.

<table>
<thead>
<tr>
<th></th>
<th>Panel A: Post-crisis frictions</th>
<th>Panel B: No fin. frictions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Y</td>
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</tr>
<tr>
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<td>1.0020</td>
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<tr>
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<tr>
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<tr>
<td>Fraction of Output Gap</td>
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<td></td>
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</tbody>
</table>