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An empirical inquiry into the role of sectoral diversification in exchange rate regime choice ☆

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ABSTRACT

Whether sectoral diversification affects the exchange rate regime choice and the mechanisms through which this effect might work are largely unknown. This study identifies two mechanisms through which sectoral diversification and exchange rate regime choice may be related, namely the external shock absorption and rent-seeking mechanisms. A direct effect of diversification on regime choice is also hypothesized. Using a panel dataset covering 91 countries over the period 1985–2006, the paper runs a 'horse race' among these potential channels. The results show that diversification is associated with flexible regimes in countries experiencing greater external shocks. Additionally, countries characterized by higher levels of corruption and lower levels of diversification opt for fixed regimes, suggesting that a fixed regime may shield the powerful elites from international competition. There is also weak evidence of the direct effect of diversification in adopting flexible regimes.

1. Introduction

There is considerable debate surrounding the possible determinants of exchange rate regimes across countries. A corpus of literature has offered no unified theory or empirical model that encapsulates all possible determinants of exchange rate regimes. Given that the factors significant for regime choices are not known *a priori*, studies have investigated a myriad of variables in their quest for the determinants (see, *inter alia*, Juhn and Mauro, 2002; Von Hagen and Zhou, 2007; Carmignani et al., 2008).

This paper focuses on sectoral diversification as one of the key determinants of exchange rate regimes. The core idea in this paper is that production patterns in the real sector are likely to shape some central macroeconomic policy choices, such as exchange rate arrangements. Despite this intuitive point, the role of sectoral diversification in exchange rate regime

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determination has not been subjected to any empirical scrutiny. Our principal objective is to fill this gap.[1] We also recognize that sectoral diversification, in addition to its direct effect, might influence the exchange rate regimes through different channels. This line of reasoning leads us to investigate the interactions of diversification with external shocks and rent-seeking as the mechanisms through which diversification might be related with the exchange rate regimes. Our approach differs from the extant empirical work, which assumes that the exchange rate regime is determined in a linear fashion, i.e., only through a direct effect, by the hypothesized variable(s).

Patterns in and the policy impacts on the real economy can be investigated through sectoral diversification. Sectoral diversification refers to the production activities in various sectors, in contrast to only a few, and is often measured using metrics capturing the relative disparities among sectoral shares. It has been demonstrated that sectoral diversification is non-monotonically related to the level of development in that economies initially experience rising levels of diversification and then tend to re-concentrate after reaching a certain level of income (Imbs and Wacziarg, 2003; Koren and Tenreyro, 2007). This finding suggests that diversification follows an inverted U-shaped pattern with respect to per capita income.

Another important feature of diversification is that it is at the center of one of the long-standing debates in economics. On the one hand, some celebrated theories, such as the Ricardian and Heckscher-Ohlin theories of international trade, promote specialization to reap the benefits of comparative advantage and productivity gains. On the other hand, another strand of literature, motivated mainly by the portfolio approach, emphasizes the risks associated with specialization. For instance, Burns (1960) considers the sectoral composition of the economy as one of the predictors of output volatility because some activities, such as agriculture, tend to be riskier than others, such as services. Thus, sectoral diversification is seen as a means of spreading production risks over a number of activities and, consequently, as a remedy for output and employment fluctuations (Kenen, 1969; Imbs and Wacziarg, 2003).[2]

As implicit in the above discussions, sectoral diversification is considered one of the key factors in exchange rate regime determination for its shock absorbing role in the economy. For instance, the output cost of exchange rate volatility, as discussed by Lahiri and Végh (2001), can be mitigated through diversification because a diversified economy is characterized by less volatile terms-of-trade and real exchange rates. On the other hand, Kenen (1969), in one of the early contributions on optimum currency areas, argues that sectoral diversification enables countries to adopt fixed regimes because it ensures a stable external sector and terms-of-trade and thus obviates the need for frequent changes in nominal exchange rates. Notwithstanding the compelling theoretical discourse, the shock absorbing effect of diversification on exchange rate regimes has not been put to an explicit empirical test in the literature.

Furthermore, other possible mechanisms through which sectoral diversification may affect exchange rate regime choice have been overlooked in the literature. This paper identifies rent-seeking as a likely additional mechanism, which, to the best of our knowledge, has also not been explored in previous work. Both the external shock and rent-seeking channels may have their own independent effects on exchange rate regimes (Von Hagen and Zhou, 2007; Alesina and Wagner, 2006); however, depending on their magnitudes, they may also facilitate or inhibit the impact of diversification and/or may differ in their degree of influence at different levels of diversification. The direct effect of sectoral diversification, on the other hand, is independent of the two mechanisms but can still exert a significant impact on exchange rate regimes. We provide theoretical underpinnings for the two mechanisms and the direct effect. Thus, taken together, this study fills two major gaps in the literature. First, it provides the empirical investigation of the impact of sectoral diversification on the *de facto* exchange rate regimes. Second, it explores whether the effects on the exchange rate regimes are independent of, and/or conditional on, external shock absorption and rent-seeking associated with diversification. We run a 'horse race' among these two identified channels and the direct effect to evaluate their relative merits. In summary, the main contribution of this paper is that it sheds light on the way in which changing production patterns in the real sector shape core macroeconomic policies such as the choice of exchange rate regimes.

The empirical analysis utilizes an annual panel dataset covering 91 countries over the period 1985–2006. We adopt the widely used *de facto*[3] exchange rate regime classification of Reinhart and Rogoff (2004) and Ilzetzki et al. (2008).[4] The categories range from 1 to 14, representing the most fixed and the most flexible regimes, respectively. Our analysis is based on the Theil index of sectoral diversification. We use two alternate constructions of the Theil index using sectoral value added and sectoral employment shares as the sectoral size measures. An advantage of the Theil index is that it enables us to decompose diversification into 'within' and 'between' components; the former is due to the reallocation of value added or employment within the existing sectors, and the latter is due to the introduction of new or the phasing out of older sectors.[5]

[1] Trade diversification has been considered in the literature for exploring different questions such as economic growth, productivity, and natural resources (see Michaely, 1958 as a pioneering work and Cadot et al., 2013 for a recent comprehensive review).

[2] Cameron (1978) argues that industrial concentration can be risk-reducing. A higher level of industrial concentration (in terms of a larger share of production and employment in a few firms) facilitates higher unionization and provides a wider scope for collective bargaining. This creates stronger labor confederations, ensuring larger income supplements in the form of social security schemes, health insurance, unemployment benefits, job training, and employment subsidies from the government. These income supplements help mitigate the external risks.

[3] The IMF classification of exchange rate regimes is based on member countries' announcements and is therefore termed as the *de jure* classification. Because countries often deviate from their announcements (Calvo and Reinhart, 2002), the *de facto* classification is used to reflect the actual exchange rates in practice.

[4] The original Reinhart and Rogoff data covered the period 1940–2001. Ilzetzki et al. (2008) extended it up to 2007.

[5] An innovative application of the Theil index in this vein is Cadot et al. (2011), who decompose export diversification into two components, one relating to the intensive and another to the extensive margin of trade.

We also adopt the Herfindahl index as an alternative measure of sectoral diversification as a robustness check. Rent-seeking is proxied by a corruption index, and external shock is measured by the standard deviation of the terms-of-trade. Our benchmark estimation employs a pooled panel because diversification changes slowly over time, thus rendering very little within-variation to allow for fixed effects estimation. To account for possible time-invariant effects, several country-fixed factors are included in the regression. Instrumental variable (IV) estimation and the heteroskedasticity-based identification proposed by Lewbel (2012) are employed to address the possible endogeneity of sectoral diversification and corruption. In the IV estimation, current diversification is instrumented by its 20-year lag, and corruption is instrumented by the percentage of Protestants in the total population. The heteroskedasticity-based identification, valid only for cross-sectional data, has the major appeal of not resting on any exclusion restrictions. The main conclusions in the paper are drawn from the marginal effects of the interaction terms, which are also illustrated graphically by portraying the portion of the constituent variable over which the effect is statistically significant.

We find that diversification is associated with flexible regimes in countries experiencing greater external shocks, a finding that contrasts with Kenen's (1969) prediction. The rent-seeking channel is also at work: lower sectoral diversification (or a higher concentration) is associated with fixed regimes in countries with higher levels of corruption. This may be due to the lobbying of powerful elites for protection from international competition through the fixed exchange rate regime. Overall, the external shock channel is statistically somewhat stronger than the rent-seeking channel. The direct effect of sectoral diversification is associated with flexible regimes, but this effect does not survive the addressing of endogeneity. Our results also indicate that the variations in exchange rate regimes are explained by the 'within' rather than the 'between' component of diversification (in both value added and employment terms). The findings remain robust after controlling for other relevant variables, including the country-fixed factors in the regressions. In the absence of any truly randomized or a quasi-natural experiment, and given the difficulties associated with teasing out the causal effects in cross-country data, we believe our results are more likely to represent robust correlations.

The rest of the paper is arranged as follows. Section 2 discusses the theoretical links among regime choice, diversification, rent-seeking, and real shocks. Section 3 describes the data and presents the descriptive statistics. Section 4 explains the estimation method. The results and discussion are provided in Section 5. Finally, conclusions are drawn in Section 6.

2. Theoretical underpinnings

The direct effect of diversification on exchange rate regime choice is not well-documented in the literature. However, an argument can be built on the "fear of floating" phenomenon put forward by Calvo and Reinhart (2002), which refers to the reluctance of most countries to float their exchange rates. Specifically, the output costs due to excessive swings in terms-of-trade and real exchange rate under floating regimes prevent the countries from adopting flexible exchange rate regimes (Lahiri and Végh, 2001).[6] Pointing to a solution, one can argue that the output cost of exchange rate volatility can be mitigated through diversification because a diversified economy is characterized by less volatile terms-of-trade and real exchange rates.[7] Consequently, sectoral diversification might reduce the 'fear of floating', and pave the way for more flexible exchange rate regimes.

2.1. External shocks, diversification, and exchange rate regime choice

The direct relationship between external shock and exchange rate regimes follows from the automatic stabilizer role of the flexible exchange rate (Friedman, 1953). A flexible regime would insulate an economy from large fluctuations in terms-of-trade in the event of a negative external shock by depreciating the nominal exchange rate. The depreciation reduces the relative price of tradable goods, which in turn offsets the negative effect of the initial shock and stabilizes the terms-of-trade (Broda, 2001).[8] Hence, countries experiencing greater external shocks are likely to be better off with flexible regimes.

The interaction effect of diversification and external shock hypothesized in this paper follows from the shock absorbing role of diversification.[9] For example, Kenen (1969) argues that a well-diversified economy will not have to undergo frequent changes in its terms-of-trade because sectoral diversification keeps a country's aggregate exports relatively stable. This is

[6] Levy-Yeyati and Sturzenegger (2007) are of the opinion that the 'fear of floating' is tantamount to the 'fear of appreciation,' which can be attributed to the 'Dutch disease' effect, leading to loss of international competitiveness and serious setbacks to export diversification (Reinhart, 2000).

[7] A counter example of this point would be Bolivia, for which Jenkins (1996) argues that the adoption of crawling peg after 1985 improved the export performance even though exports were very much concentrated in a few products. It must, however, be noted that export products are a part of the overall production structure in the economy.

[8] The insulation property of flexible exchange rate regimes is well-established empirically; see Broda (2001, 2004), Hoffman (2007) and Ramcharan (2007). Broda (2004), using a panel VAR, finds that in the event of terms-of-trade shocks, the adjustment to the economy is better under a flexible exchange rate regime. Hoffman (2007) extends this analysis to an examination of whether the better adjustment capacity of flexible regimes can be established for other kinds of external shocks, such as world output and world interest rate shocks.

[9] Ramcharan (2005) empirically examines the effectiveness of diversification for mitigating the cost of shocks. He measures the cost of shocks as the impact of earthquake shocks on a country's consumption. Using a panel of 39 countries over the period 1971–2001, he finds that sectoral specialization greatly magnifies the cost of shocks.

less likely in a concentrated economy because sector-specific external shocks are not averaged out. On the policy side, pointing to two crucial tools of shock absorption, Corden (2002) posits that the costs of abandoning independent monetary and exchange rate policies, are likely to be lower in a diversified economy because of the relative stability of the terms-of-trade and real exchange rates.[10] These arguments suggest that the insulation property of flexible regimes is weakened (reinforced) by the presence of a concentrated (diversified) production structure. On the other hand, the 'fear of floating' effect, which is the direct effect of sectoral diversification on exchange rate regime choice as described above, is magnified in economies that face higher real external shocks. Therefore, countries experiencing stronger external shocks are *a priori* expected to adopt more flexible regimes if they have a diversified production structure.

2.2. Rent-seeking, diversification, and exchange rate regime choice

In the absence of any well-established theoretical argument, the direct effect of rent-seeking on exchange rate regimes is unclear. Nevertheless, rent-seeking is likely to act as a mechanism through which diversification influences regime choice. The argument is predicated on the political economy literature. When rent-seeking channels are widespread, the concentration of production in the hands of a few may lead the interest groups to lobby for protection through the exchange rate regimes.[11] The government may grant protection to such groups by fixing the currency at a devalued rate to cover their lack of competitiveness in international markets. Thus, in a political equilibrium, a fixed regime may emerge as an outcome of what is now well known as 'special interest politics' (Grossman and Helpman, 2001). The mechanism is analogous to the determination of trade policy with tariff rates as an instrument of protection in that a lobbying process may be behind the exchange rate regime choice. Conversely, a higher level of diversification implies that the economy is more likely to see competition and efficiency. Even in the presence of the rent-seeking channels, a diversified economic structure would mean a greater number of interest groups, more political competition (which would cancel out each group's demands), and limited rewards from a given lobbying activity. This would be reflected in the choice of a more flexible exchange rate regime. Therefore, a country characterized by a higher level of diversification (concentration) and lower (higher) scope for rent-seeking is likely to opt for a more flexible (fixed) exchange rate regime.[12]

3. Data and descriptive statistics

We start our analysis with a panel dataset covering 135 developed and developing countries and the period 1985–2006. However, the number of countries in the sample drops to 91 for the 'horse race' specification on which our inference is based. The time period is restricted by the data availability of the variables included in the econometric analysis. As mentioned above, we adopt the widely used *de facto* exchange rate regimes compiled by Reinhart and Rogoff (2004), where the categorization of regimes is based on the actual behavior of exchange rates observed from parallel or dual exchange rate markets. The Reinhart–Rogoff regimes are listed in Appendix Table A1.

The sectoral diversification measures are constructed by using the INDSTAT2 (2012) ISIC Rev.3 database, which provides manufacturing data at the 2-digit level of disaggregation in accordance with the International Standard Industrial Classification (ISIC). The database includes the value added and employment volumes for 23 manufacturing sectors and covers a wide range of countries over the period 1963–2009. Our main diversification measure is the Theil index, where a lower value indicates a higher level of diversification, and vice versa. Because there really is no standard way to measure diversification at the level of aggregation under consideration, we construct two Theil indices that are based on sectoral value added and sectoral employment shares. Importantly, we also take advantage of the decomposition property of the Theil index to separate diversification into 'within' and 'between' components. Specifically, the index can be partitioned additively into within and between group (sector) components, referring, respectively, to diversification taking place within existing sectors and diversification arising due to the introduction of new and/or the phasing-out of older sectors.[13] To cross-check the results with the Theil index, we also use an alternative measure of diversification, the Herfindahl index, which again is based on value added and employment shares. This index takes values between 0 and 1, where a lower value indicates a higher level of diversification, and vice versa. The four diversification measures used in this study are highly correlated, with a minimum correlation between any pair being 0.72.

External shock is the five-year backward moving standard deviation of the terms-of-trade defined as the percentage ratio of the export unit value index to the import unit value index relative to the base year 2000. Rent-seeking is proxied by the

[10] Kenen (1969) and Corden (2002) provide these arguments in support of the formation of a currency union (which is itself a fixed regime from the viewpoint of the member countries). Although a currency union may have other benefits, such as increased trade among members (Frankel and Rose, 2002), the above argument does not necessarily imply that a currency union is the best choice for an economy vulnerable to external shocks.

[11] This negative relationship between diversification and rent-seeking behavior is documented by several authors. For example, Ades and Di Tella (1999) document that corruption, a proxy for rent-seeking, is higher in an economy dominated by few firms. More specialized production structures facilitate the capture of resources by the powerful elite, thus increasing the scope for rent-seeking.

[12] A case in point would be South Korea. Kim and Kim (2005) demonstrate that the adoption of the fixed exchange rate regime and subsequent changes towards managed float in South Korea after the 1990s can be explained by the interest group pressures and associated incentives led by the bureaucracy. The proposed channel in this paper considers sectoral diversification as the determinant of the degree of interest group pressure on the government whereby a concentrated economic structure is likely to be associated with stronger interest group pressure due to lack of political competition.

[13] We follow a similar approach as in Cadot et al. (2011, pp. 594–6).

Table 1
Descriptive statistics.

Variable	Country	Obs	Mean	Median	Std. Dev.	Min	Max
Exchange rate regime choice	178	3445	6.91	7	4.38	1	14
Diversification (Value added based)	121	1816	0.83	0.73	0.44	0.24	2.47
Diversification (within) (Value added based)	113	1652	0.56	0.47	0.30	0.14	1.88
Diversification (between) (Value added based)	110	1375	0.32	0.25	0.29	0.04	2.04
Diversification (Employment based)	134	1938	0.77	0.64	0.41	0.22	2.80
Diversification (within) (Employment based)	125	1776	0.51	0.45	0.26	0.22	2.80
Diversification (between) (Employment based)	122	1393	0.30	0.25	0.27	0.12	2.37
External shock	130	2167	9.68	5.71	12.30	0.23	181.3
Corruption index	134	2496	3.17	3.00	1.39	0	6

Note: The sectoral diversification measures refer to the Theil index. The 'within' and 'between' components of sectoral diversification refer to the intensive and extensive margins of diversification, respectively, as obtained via Theil decomposition.

corruption index constructed by the International Country Risk Guide (ICRG) and is measured on a 0 to 6 scale, with a higher score representing a lower degree of corruption. Both measures are standard in the literature. Appendix Table A2 describes all the variables considered in this study and their data sources.

Table 1 presents the descriptive statistics of the key variables. Both the mean and median of the exchange rate regime is centered at approximately 7, implying a crawling peg, on average. The mean values of the diversification measures based on the Theil index range from 0.77 to 0.83.

4. Empirical analysis

4.1. Estimating equation

To test the role of sectoral diversification and the potential channels identified in exchange rate regime choice, we formulate the following empirical specification:

$$regime_{it} = \beta_0 + \gamma_i + \eta_t + \beta_1 div_{it} + \beta_2 corrup_{it} + \beta_3 shock_{it} + \beta_{12} div_{it} * corrup_{it} + \beta_{13} div_{it} * shock_{it} + X_{it}\delta + \varepsilon_{it}, \quad (1)$$

where $regime_{it}$ is the Reinhart and Rogoff (2004) *de facto* exchange rate regime classification, div_{it} is the (reverse) measure of sectoral diversification, $shock_{it}$ is the external shock and $corrup_{it}$ is the corruption index of country i at time t.

The extant empirical literature identifies a large number of potential determinants of exchange rate choice (Juhn and Mauro, 2002). In the present analysis, we focus on a select few that are likely to be correlated with the variables of our main interest, namely, diversification, shock and corruption, so that the regression does not suffer from the omitted variable bias. Hence, the $\mathbf{X}_{i,t}$ vector comprises per capita income and its square, log of population, and trade openness. Countries with different income levels may opt for different exchange rate regimes, and thus, per capita income is intended to capture this difference. Income level is also correlated with diversification (Imbs and Wacziarg, 2003) as well as corruption. Population is employed as a control for country size because, for instance, a small country may not be able to afford to diversify its production structure. Trade openness is related to shocks, as open countries are more vulnerable to external shocks. The country-fixed characteristics denoted by γ_i can also potentially be correlated with our main variables of interest. Thus, we include dummies for landlocked country, colonial origin, and oil exporting status. The landlocked dummy accounts for the geographic features (natural barriers to trade) of a country that might in turn determine its production pattern (Poirson, 2001; Ramcharan, 2010). Colonial origin captures the historical institutional factors and other ties that may also have a bearing on the current production structure. Similarly, a dummy for oil exporters is related to both diversification and exchange rate choice. η_t is the aggregate time effects that are captured by year dummies.

As indicated in Section 2, the sign of β_1, reflecting the direct effect of diversification, is expected to be negative because a lower value of the diversification index (a more diversified structure) should lead to flexible regimes. Based on the discussions in Section 2, the predicted signs of the direct effects of external shock and corruption will be positive and ambiguous, respectively. The anticipated sign of the coefficient of the interaction term of diversification with external shock is negative and that of diversification with corruption is positive.

In a model with interaction term(s), singular attention to the magnitude and significance of the individual coefficients may lead to the omission of important information. For an accurate inference, one needs to consider the marginal effect of the 'focal' explanatory variable conditional on the levels of the 'moderator' variable(s). In Eq. (1), *div* is the focal independent variable, and *shock* and *corrup* are moderator variables. Consequently, we focus on the derivative $(\partial regime/\partial div) = \beta_1 + \beta_{12} corrup + \beta_{13} shock$. To obtain the values of corruption (shock) at which diversification significantly affects regime choice, we evaluate the marginal effect at the mean of shock (corruption). The corresponding standard errors and 90% confidence interval (CI) are derived using the 'delta method.' A joint significance test of the coefficients of the direct effect and interaction effects is also conducted (Wooldridge, 2002).

4.2. Estimation strategy

In our setting, the fixed effects estimation will provide insignificant results because of little within-variation in diversification and, to a large extent, in corruption due to large persistence over time. The random effects estimator is a matrix-weighted average of the between- and within- effects, so whatever variation it picks up is likely to be the between-variation in our case. Therefore, our baseline approach is a pooled panel analysis controlling for common time effects and clustering the standard errors at the country level. Clustering standard errors also addresses the serial correlation in the shock measure, given that it is the five-year backward moving standard deviation of the terms-of-trade. To confirm that the results are mainly due to between-variation, we also estimate a cross-sectional model where the relevant variables are averaged over time.

Treatment of the dependent variable as continuous or discrete is another important estimation issue. Countries choose a set of exchange rate arrangements from a continuum of policy choices. The *de facto* classification of Reinhart–Rogoff categorizes this spectrum into 14 groups. If two countries differ only slightly in their exchange rate arrangements, they are likely to be placed in the same group. For countries to be allocated into different groups, they must have made sufficiently different policy choices. The question is whether these 14 groups should be treated as ordinal or continuous variables rounded to integers. Even if one views these categories as ordinal, it seems that having 14 different regimes makes the underlying categorization nearly indistinguishable from a continuous measure.[14] Thus, without much loss of generality, we treat the dependent variable as continuous.[15]

Eq. (1) is first estimated by OLS as the benchmark. However, endogeneity may arise because of reverse causation. For instance, a fixed exchange rate may insulate the existing sectors from competition or inhibit the formation of new sectors, thus influencing diversification. Corruption might also suffer from the same problem in that protection may create more rent-seeking opportunity. Endogeneity may also arise due to omitted variables; exchange rate choices and diversification (and corruption) might be caused by the same factors omitted from the regression equation. We address the endogeneity of these two key variables through an instrumental variable estimation and heteroskedasticity-based identification. External shock is treated as exogenous because the fluctuations in terms-of-trade are mostly external to a country (Mendoza, 1995).[16]

4.2.1. Instrumental variable estimation

Ideally, an instrumental variable should approximate a randomized experiment, but it is difficult to find such an experiment in practice. With the assumption that endogeneity is primarily due to reverse causation, we use the 20-year lag value of diversification as an instrument to predict the current trajectory of diversification. This deep lag is less likely to be contaminated by reverse causation. The percentage of Protestants in the total population is used as the instrument for corruption. It is generally argued that the Protestant church and its institutions may play a role in monitoring and denouncing abuses by state officials (Triesman, 2000). Furthermore, it is considered that a stronger separation of the Protestant church from the state leads to a civil society that is effective at monitoring the state.[17] In regard to satisfying the exclusion restrictions assumptions, the econometric specification already controls for possible observable factors such as the level of development, country size, and dummies for landlocked and colonial past. Thus, possible channels between diversification levels of 20 years ago and contemporaneous diversification are likely to be blocked. The Protestant religion seems to satisfy exclusion restrictions more strongly because there is no direct causal link between Protestantism and the exchange rate regime choice. Meanwhile, the interaction of diversification with external shock is instrumented by the interaction of 20-year lagged diversification with external shock, and the interaction of diversification with corruption is instrumented by the interaction of 20-year lagged diversification with the percentage of the Protestant population.

An additional strategy to address the endogeneity problem is to restrict the sample to countries that are less susceptible to the possible causes. To the extent that certain countries may induce omitted variable bias into the error term, their removal from the sample can allow for addressing the problem neatly. An explicit case is the policy-induced omitted variables. We identify two specific sources of such bias that might affect a good number of countries in the sample, namely, export-promoting (EP) and import-substituting (IS) countries. The EP economies typically kept their exchange rates depreciated to boost their exports, which might in turn have affected their diversification levels. The IS countries adopted various policies aimed at protecting their 'infant' industries as a development strategy. Although such policies predominantly included tariffs and non-tariff barriers, the exchange rate regimes might have been affected when the IS policies succumbed to the bottlenecks and crises. Therefore, we also estimate the benchmark model excluding these two sets of

[14] The Monte Carlo simulations of Johnson and Creech (1983) demonstrate that grouping a continuous measure into a finite number of categories is unlikely to create a measurement error problem if the number of categories is greater than five. In a different context, Ferrer-i-Carbonell and Frijters (2004) find that cardinality vs. ordinality assumptions regarding happiness scores make little difference to the results.

[15] Aghion et al. (2009) also treat the Reinhart–Rogoff classification as continuous and use it as an explanatory variable by taking its five-year average. Similar treatments of other variables in the same vein are not uncommon in the literature. For instance, scores for Polity IV or Freedom House political rights and civil liberties are often used both as the dependent variable and the lagged dependent variable or explanatory variables.

[16] Controls such as per capita income and its quadratic, as well as trade openness, might also be endogenous. Notwithstanding being a limited solution, a one period lag of these variables is used in the pooled panel analysis, and their initial values are used in the cross-sectional analysis.

[17] We would like to thank an anonymous referee for this suggestion. We initially included all major religions as instruments in the first stage and found that all but Protestantism are similar in the degree of corruption observed in a country. The Protestantism indicator remained robustly significant with the expected negative sign, indicating lower tendency for perceived corruption compared with all other religions.

countries in alternate samples.[18] A further advantage of their exclusion is the ability to test the stability of the results in alternative samples.

4.2.2. Identification through heteroskedasticity

One may argue that our IV approach thus far has limitations in that unobservables, such as historical trade links, entrepreneurship, and various other determinants of economic and political equilibria, might have played a role in the determination of the right-hand-side variables and exchange rate regimes. Similarly, the exclusion of some countries can address only group-specific omitted variables. Consequently, we employ an alternative identification approach exploiting heteroskedasticity proposed recently by Lewbel (2012). The appeal of this method is that, unlike the standard IV estimation, it does not rely on exclusion restrictions; rather, it exploits the heteroskedastic residuals for identification. The method is valid only for cross-sectional data and has seen a growing number of applications because it enables generating IVs from within the model, even in the absence of any suitable external instrument.[19] To provide an abridged description of the method, consider a regression equation $Y=\mathbf{X}\beta+\mathbf{W}\gamma+e$, where $\mathbf{X}$ is the vector of endogenous variables and $\mathbf{W}$ is the vector of exogenous variables. Initially, a set of exogenous variable(s), $\mathbf{Z}$, where $\mathbf{Z}\in\mathbf{W}$, or even $\mathbf{Z}=\mathbf{W}$, is identified.[20] Then, the endogenous variables in $\mathbf{X}$ are regressed on the $\mathbf{Z}$ vector, which is followed by the retrieval of the residuals, $\hat{\varepsilon}$. Using these residuals, $(Z_i-\overline{Z}_i)*\hat{\varepsilon}$ is constructed for the ith member of $\mathbf{Z}$, where $\overline{Z}_i$ is the mean of Z_i, which can be used like standard instrumental variables in the second stage. For this strategy to work, the residuals $\hat{\varepsilon}$ must be heteroskedastic. The second-stage regression can be estimated by the standard IV or GMM method.

To apply the method, we first convert the panel dataset so that it is cross-sectional. Then, to obtain the instruments, we include shock, the initial income and its square, trade openness, log population and the country fixed factors in the $\mathbf{Z}$ vector. Once the IVs are generated as per the discussion above, the models are estimated in the second stage by GMM. Because we have at our disposal more than one instrument for each endogenous variable, our models are over-identified.

5. Results

The results reported in the print version of this paper are based on the diversification measures constructed using the Theil index.[21] We first present the benchmark OLS results. Next, the IV results are outlined, and then the findings from the heteroskedasticity-based identification are discussed.

5.1. OLS results

The OLS results are reported in Table 2. Columns 1–3 present the results using diversification based on sectoral value added, and columns 4–6 present the same for sectoral employment. Column (1) outlines the findings from the 'horse race' model, which includes both the shock and corruption channels simultaneously. The coefficient of the direct effect of diversification is negative and significant at the 1% level, implying that greater sectoral diversification (as indicated by the lower value of the diversification index) is associated with more flexible exchange rate regimes. This finding supports the argument that sectoral diversification mitigates the fear of floating. Meanwhile, the direct effect of external shock is significant and positive, pointing to the shock absorbing role of flexible exchange rate regimes, yet the direct effect of corruption is negative but insignificant. Testing the hypothesized channels in this paper, the point estimates of the interactions of diversification with external shock and corruption are significant at the 1% level. The negative and significant interaction of diversification with external shock implies that countries experiencing greater external shocks can afford more flexible exchange rate regimes if they have a diversified production structure. This result supports the shock absorbing role of diversification, which reinforces the automatic stabilizer role of flexible exchange rate regimes (which, in turn, refers to the direct effect of external shock).[22] Furthermore, the positive and significant coefficient of the interaction with corruption provides an initial support for the rent-seeking argument in Section 2 in that a country characterized by a lower level of diversification and a higher scope for rent-seeking is likely to opt for a more fixed exchange rate regime.

Column (2) presents the results where only corruption is interacted with diversification. The results are consistent with the 'horse race' model in terms of the sign and statistical significance of the coefficients. Analogously, considering only the shock mechanism in the specification supports the related previous finding except that the direct effect of diversification now becomes insignificant (column 3). The results do not meaningfully change when the sectoral employment shares are used to construct the diversification index (columns 4–6).

[18] We follow the IS and EP country classification of Balasubramanyam et al. (1996).
[19] Other studies using the Lewbel method include Mallick (forthcoming) and Emran and Hou (2013).
[20] $\mathbf{Z}$ can also include suitable external instruments, if available.
[21] The results based on the Herfindahl index are qualitatively similar and therefore not discussed; they can be found in online Appendix.
[22] The findings also suggest that the coefficients of diversification and its interactions are jointly statistically significant, as shown by F-tests.

Table 2
Sectoral diversification and exchange rate regime choice – Pooled panel OLS estimation.

Variables	Diversification based on sectoral value added share			Diversification based on sectoral employment share		
	(1)	(2)	(3)	(4)	(5)	(6)
div	−5.002***	−6.731***	−0.407	−4.864**	−6.256***	−1.736
	(1.936)	(1.992)	(1.049)	(2.022)	(2.014)	(1.250)
div*corrup	1.408***	1.521***		0.977*	1.059**	
	(0.496)	(0.509)		(0.531)	(0.535)	
div*shock	−0.178***		−0.186***	−0.139***		−0.159***
	(0.056)		(0.059)	(0.050)		(0.053)
corrup	−0.389	−0.506		−0.085	−0.174	
	(0.515)	(0.524)		(0.521)	(0.527)	
shock	0.174***		0.182***	0.137**		0.152***
	(0.061)		(0.062)	(0.057)		(0.059)
No. of countries	85	85	85	91	91	91
No. of observations	1273	1273	1273	1296	1296	1247
R-squared	0.274	0.254	0.228	0.246	0.236	0.225
Joint Sig. (Chi2, *p*-val.)	21.86 (0.00)	11.42 (0.00)	14.09 (0.00)	19.80 (0.00)	10.97 (0.00)	17.26 (0.00)

Notes: Robust standard errors clustered at the country level in parentheses. All regressions include the lag of income per capita and its square, the lag of trade openness, log population, dummies for oil exporting countries, landlocked countries and colonial origins, as well as year dummies and a constant. Joint sig. refers to the joint significance of the coefficients of diversification and the interaction term(s). Variable descriptions are provided in Appendix Table A2.

*** Statistical significance at the 1% levels.

** Statistical significance at the 5% levels.

* Statistical significance at the 10% levels.

5.2. IV Results

This sub-section outlines the results with the IV estimation. Initially, we discuss the first-stage and reduced form findings to assess the validity and relevance of the instruments. It is worth reiterating that sectoral diversification is instrumented with its 20-year lag, and corruption is instrumented with the percentage of Protestants in the total population.

5.2.1. First-stage and reduced form results

Appendix Table A3 presents the test results relating to the reliability of our instruments. The first-stage regressions demonstrate that diversification 20 years ago is a significant predictor of the current level of diversification – this holds in the cases of both value added and employment as sectoral size measures (columns 1 and 2). While *F*-statistics are generally high across different diversification metrics, the Shea partial R^2 values range between 0.18 and 0.20, suggesting that the instrument may not be strong enough. However, the instrument is not under-identified, as suggested by the Kleibergen-Paap rk LM statistics. The Protestant religion is also a significant predictor of the level of corruption (column 5), but again with mixed indications in terms of instrument strength based on the *F*-statistic and Shea partial R^2 values. The scatter plots in Appendix Figs. A1–A3 (both non-parametric and parametric) also confirm the positive relationship between our IVs and the respective endogenous variables. The reduced form specifications, which examine the direct link between regime choice and the instruments controlling for baseline covariates, show the absence of such relationship (columns 3–4 and 6 in Appendix Table A3).

5.2.2. Second-stage results

The second-stage IV results are reported in Table 3. Each regression is accompanied by a set of test results, including the first-stage *F*-statistics on excluded instruments for four endogenous variables in the respective models: diversification, corruption, and the two interactions of diversification. The *F*-statistics indicate a possible weak instrument problem in the case of diversification, especially when it is based on value added, given that the test statistics are not clearly higher than the Stock and Yogo (2005) cut-off. To address this problem, we estimate the IV regressions by the Limited Information Maximum Likelihood (LIML) method, which is robust to the weak instruments problem.[23]

Column (1) in Table 3 presents the IV-LIML results for the 'horse race' model when the diversification measure is based on value added. The external shock and corruption channels are significant at the 5% level, similar to the OLS results. The negative sign of the interaction term of diversification with external shock corroborates the shock absorbing role of the flexible exchange rate regime. Conversely, the positive coefficient of the interaction of diversification with corruption confirms the rent-seeking channel documented by the OLS estimation. Column (1) also shows that the direct effect of diversification is marginally insignificant but remains negative, indicating the mitigation of 'fear of floating'. Both the external shock and corruption channels remain robust when considered in isolation (columns 2 and 3). Moreover,

[23] The results (not reported) are similar if estimated by the 2SLS.

Table 3
Sectoral diversification and exchange rate regime choice – Pooled panel IV estimation.

Variables	Diversification based on sectoral value added share			Diversification based on sectoral employment share		
	(1)	(2)	(3)	(4)	(5)	(6)
div	−9.891	−11.130*	0.781	−3.224	−4.502	0.356
	(6.119)	(6.419)	(2.156)	(5.089)	(5.315)	(2.438)
div*corrup	3.142**	3.153**		1.448	1.574	
	(1.356)	(1.362)		(1.091)	(1.128)	
div*shock	−0.228**		−0.342***	−0.139		−0.212**
	(0.090)		(0.103)	(0.103)		(0.085)
corrup	−1.230	−1.146		−0.081	−0.095	
	(1.455)	(1.472)		(1.295)	(1.298)	
shock	0.200**		0.325***	0.135		0.193**
	(0.097)		(0.112)	(0.105)		(0.093)
No. of countries	75	75	76	77	77	78
No. of observations	968	968	969	994	994	995
Joint Sig. (Chi2, *p*-val.)	16.21 (0.00)	6.88 (0.03)	11.06 (0.00)	5.50 (0.13)	2.54 (0.28)	6.24 (0.04)
1st stage *F*-stat1	4.82	5.92	6.75	24.88	31.46	13.57
1st stage *F*-stat2	9.49	13.20	–	16.05	22.37	–
1st stage *F*-stat3	11.55	–	13.38	19.20	–	13.12
1st stage *F*-stat4	18.92	25.14	–	16.90	22.93	–
Under-identification test	6.94 (0.01)	6.60 (0.01)	8.65 (0.00)	14.91 (0.00)	13.47 (0.00)	9.73 (0.00)

Notes: Robust standard errors clustered at the country level in parentheses. All regressions include the lag of income per capita and its square, the lag of trade openness, log population, dummies for oil exporting countries, landlocked countries and colonial origins, as well as year dummies and a constant. Sectoral diversification is instrumented by its 20-year lag, and corruption is instrumented by the percentage of Protestants in the total population. The equation is estimated by the LIML-Fuller(k) method. *F*-stat1, *F*-stat2, *F*-stat3 and *F*-stat4 are the first-stage *F*-statistics for div, div*corrup, div*shock and corrup, respectively. Under-identification test refers to the Kleibergen-Paap rk LM statistic and its *p*-value. Joint sig. refers to the joint significance test of the coefficients of diversification and the interaction term(s). Variable descriptions are provided in Appendix Table A2.

*** Statistical significance at the 1% levels.

** Statistical significance at the 5% levels.

* Statistical statistical significance at the 10% levels.

the coefficients of diversification and its interactions are jointly statistically significant at any conventional level. Finally, the *p*-value of the Kleibergen-Paap rk LM statistic rejects the null of under-identification.

Columns 4–6 replicate the results with the diversification measure based on sectoral employment. The coefficients are significant only when the shock channel is investigated in isolation (column 6). Nonetheless, their signs generally accord with those in Table 2 and in columns 1–3 in Table 3. For example, the interaction between diversification with corruption is positive, and the *t*-statistics range between 1.3 and 1.4 across the three models investigated. The interaction of diversification with external shock is negative with a relatively higher *t*-statistic. The direct effect of diversification is always insignificant. All three specifications reject the null of under-identification. The coefficients of diversification and its interactions are jointly significant only for the specification in column 6.

In general, the estimated IV coefficients are larger in magnitude, and their standard errors are relatively higher compared with those obtained by OLS. The latter point is conceivable because of the inefficiency of the IV estimator. A comparison of the results in columns (1)–(3) and (4)–(6) demonstrates that value-added based diversification gives more statistically significant results than the employment based diversification. The reason for this result, we conjecture, is that the employment based measure has a low within variance, a problem that is exacerbated when it is instrumented by its own 20-year lag. Moreover, there is the inefficiency of the IV estimator. The parallel economic arguments suggest that value added shares in a sector change more frequently than employment shares because changes in value added are the result of changes in both employment and other factors, such as prices.

Decomposition of the Theil index provides additional insights into the results. Table 4 reports the IV-LIML results when diversification is separated into its 'within' and 'between' components.[24] It is clear that the findings based on the 'within' component of diversification, presented in columns (1)–(3) and (7)–(9), mimic the respective results in Table 3 obtained with the aggregate diversification. Patterns across the 'horse race' and isolated channel models and the alternative measures of diversification are quite comparable. Considering the 'between' component, no coefficient is estimated to be significant (columns 4–6 and 10–12).

These results, therefore, suggest that the changes within the existing sectors rather than the introduction of new or the phasing-out of older sectors drives the variation in the exchange rate choices among countries. Because there is little within-variation in the employment share, the IV results are insignificant. Conversely, the value added based diversification is more significant because of the possible higher within-variation. To put this result in perspective, it is instructive to mention Cadot et al.'s (2013) finding that most of the variations between export diversification and income per capita are

[24] The first-stage regressions are similar to the case of the overall Theil index.

Table 4
The 'within' and 'between' components of sectoral diversification and exchange rate regime choice – Pooled panel IV estimation.

Variables	Panel A: Diversification based on sectoral value added share						Panel B: Diversification based on sectoral employment share					
	'Within' decomposition			'Between' decomposition			'Within' decomposition			'Between' decomposition		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
div	−14.832	−21.896**	1.084	−33.135	−30.865	3.709*	−5.663	−22.202	2.145	65.521	59.338	9.332**
	(9.762)	(10.528)	(6.397)	(54.058)	(45.718)	(2.170)	(15.447)	(18.190)	(7.550)	(46.403)	(47.468)	(4.759)
div*corrup	3.737**	4.424***		12.516	12.572		2.335	4.497		−14.748	−17.667	
	(1.725)	(1.695)		(18.678)	(17.184)		(2.500)	(2.949)		(13.438)	(15.099)	
div*shock	−1.111***		−1.231***	0.352		−0.149	−1.227**		−1.341**	−1.649		−0.193
	(0.412)		(0.441)	(0.629)		(0.134)	(0.493)		(0.540)	(1.203)		(0.220)
corrup	−2.032	−2.186		0.665	0.580		−0.419	−1.285		1.148	1.816	
	(1.884)	(1.962)		(2.371)	(2.365)		(1.835)	(1.966)		(2.186)	(2.350)	
shock	0.688**		0.794***	−0.223		−0.036	0.729**		0.805**	0.516		
	(0.271)		(0.278)	(0.233)		(0.075)	(0.306)		(0.334)	(0.499)		
No. of countries	64	64	64	60	60	60	65	65	65	60	60	60
No. of observations	605	605	605	426	426	426	624	624	624	395	395	395
Joint Sig. (Chi2, *p*-val.)	12.53 (0.01)	6.82 (0.03)	8.22 (0.02)	0.91 (0.82)	0.78 (0.68)	3.60 (0.16)	8.08 (0.04)	2.71 (0.26)	6.18 (0.05)	2.76 (0.43)	1.58 (0.45)	5.37 (0.07)
1st stage *F*-stat1	4.33	5.16	6.43	10.03	11.25	19.60	6.80	9.08	6.50	5.56	4.13	0.09
1st stage *F*-stat2	6.73	6.88	–	5.12	4.62	–	7.98	10.58	–	2.15	2.21	–
1st stage *F*-stat3	3.97	–	7.02	14.75	–	15.57	4.88	–	6.73	7.60	8.74	7.79
1st stage *F*-stat4	17.42	23.02	–	4.93	6.27	–	16.16	21.64	–	9.04	–	–
Under-identification test	5.40 (0.02)	4.51 (0.03)	9.20 (0.00)	0.11 (0.74)	0.08 (0.02)	2.93 (0.09)	4.46 (0.03)	3.84 (0.05)	6.28 (0.01)	1.14 (2.28)	0.22 (0.64)	0.01 (0.93)

Notes: The 'within' and 'between' components of sectoral diversification refer to the intensive and extensive margins of diversification, respectively, as obtained via the Theil index decomposition. Robust standard errors clustered at the country level in parentheses. All regressions include the lag of income per capita and its square, the lag of trade openness, log population, dummies for oil exporting countries, landlocked countries and colonial origins, as well as year dummies and a constant. Sectoral diversification is instrumented by its 20-year lag, and corruption is instrumented by the percentage of Protestants in the total population. The equation is estimated by the LIML-Fuller(*k*) method. *F*-stat1, *F*-stat2, *F*-stat3 and *F*-stat4 are the first-stage *F*-statistics for div, div*corrup, div*shock and corrup, respectively. Under-identification test refers to the Kleibergen-Paap rk LM statistic and its *p*-value. Joint sig. refers to the joint significance test of the coefficients of diversification and the interaction term(s). Variable descriptions are provided in Appendix Table A2.

*** Statistical significance at the 1% levels.

** Statistical significance at the 5% levels.

* Statistical significance at the 10% levels.

Table 5
Sectoral diversification and exchange rate regime choice (sub-sample analysis).

Variables	Diversification based on sectoral value added share				Diversification based on sectoral employment share			
	(1) OLS	(2) OLS	(3) IV	(4) IV	(5) OLS	(6) OLS	(7) IV	(8) IV
div	−5.450***	−3.953*	−5.475	−9.427*	−6.179***	−4.949**	−3.656	7.268
	(2.011)	(2.022)	(6.493)	(4.993)	(1.929)	(2.430)	(4.653)	(9.822)
div*corrup	1.289**	1.381***	1.954	3.384***	1.044**	0.974	1.102	−0.343
	(0.501)	(0.535)	(1.455)	(1.306)	(0.500)	(0.623)	(0.966)	(1.866)
div*shock	−0.116**	−0.282***	−0.193**	−0.286***	−0.085*	−0.193**	−0.111	−0.197
	(0.055)	(0.071)	(0.082)	(0.100)	(0.047)	(0.077)	(0.082)	(0.178)
corrup	−0.260	−0.207	−0.452	−0.980	−0.035	−0.014	0.148	1.102
	(0.535)	(0.591)	(1.624)	(1.172)	(0.530)	(0.609)	(1.311)	(1.348)
shock	0.105*	0.278***	0.170*	0.260**	0.063	0.189**	0.083	0.193
	(0.057)	(0.090)	(0.088)	(0.119)	(0.052)	(0.088)	(0.091)	(0.169)
No. of countries	70	58	60	52	74	64	61	54
No. of observations	1043	892	765	730	1076	898	815	713
R-squared	0.381	0.390	–	–	74	64	–	–
Joint Sig. (Chi2, *p*-val.)	15.57 (0.00)	20.71 (0.00)	10.55 (0.01)	19.98 (0.00)	19.20 (0.00)	16.51 (0.00)	3.27 (0.35)	6.35 (0.09)
1st stage *F*-stat1			5.39	5.82			30.62	45.73
1st stage *F*-stat2			9.38	9.00			32.19	22.22
1st stage *F*-stat3			14.74	17.76			26.57	21.14
1st stage *F*-stat4			19.52	16.62			17.30	15.21
Under-id test			6.60 (0.01)	5.40 (0.02)			13.82(0.00)	4.98(0.03)
Countries excluded	EP	IS	EP	IS	EP	IS	EP	IS

Notes: Robust standard errors clustered at the country level in parentheses. All regressions include the lag of income per capita and its square, the lag of trade openness, log population, dummies for oil exporting countries, landlocked countries and colonial origins, as well as year dummies and a constant. Sectoral diversification is instrumented by its 20-year lag, and corruption is instrumented by the percentage of Protestants in the total population. The equation is estimated by the LIML-Fuller(k) method. *F*-stat1, *F*-stat2, *F*-stat3 and *F*-stat4 are the first-stage *F*-statistics for div, div*corrup, div*shock and corrup, respectively. Under-identification test refers to the Kleibergen-Paap rk LM statistic and its *p*-value. Joint sig. refers to the joint significance test of the coefficients of diversification and the interaction term(s). Variable descriptions are provided in Appendix Table A2. EP=Export-promoting; IS=Import-substituting.

*** Statistical significance at the 1% levels.

** Statistical significance at the 5% levels.

* Statistical significance at the 10% levels.

due to intensive margins of trade (i.e., existing export products), but the non-monotonic relationship between the same is driven by extensive margins (new products, or new markets for existing products). This is because low-income countries may open new export lines and richer countries may discontinue existing export lines driven by their comparative advantages. Thus, one implication of our finding above is that, unlike existing sectors, sectors that are introduced only recently or those that are too old to be phased out may not be able to engage in rent-seeking or are less affected by external shocks. Existing sectors exhibit more variation in this respect and, hence, pave the way for the choice of certain exchange rate regimes.

5.3. *Considering different sub-samples*

Table 5 presents the results for different sub-samples. The key objective here is not only to address the omitted variable bias but also to test the robustness of our results to variations in samples. Considering policy-based omitted variables, we exclude 15–17 export-promoting and 27 import-substituting countries from the sample. It is important to mention that these are different sets of developing countries.[25] We focus only on the 'horse race' model and estimate it both by OLS and IV-LIML. Columns (1)–(4) report the results for diversification based on value added. When the export-promoting (EP) countries are excluded, the OLS results in column (1) strongly support the previous findings that the direct effect of diversification is negative, and its interactions with external shock and corruption are negative and positive, respectively. On the other hand, after excluding import-substituting (IS) countries, the OLS results remain quite similar both in terms of the sign and significance (column 2). It is clear that OLS allows greater variation in the data. The results obtained by the IV-LIML for the 'trimmed' samples (columns 3–4) are similar to those obtained for the full sample by the IV-LIML except that the standard errors are slightly higher, which is most likely because of smaller sample size. This pattern of results holds comparably with the employment based diversification as well (columns 5–8).

In an unreported analysis, we also experiment with omitting 10 oil-exporting and 16 Latin American countries. Oil exporting countries lack diversification and usually follow fixed regimes. On the other hand, Latin American countries exhibit frequent switches in their exchange rate regimes and are associated with high levels of corruption. The OLS and IV-LIML results excluding these two sets of countries from the full sample do not change the results meaningfully,

[25] Excluding both sets of countries yields results comparable to those excluding only the EP countries.

Table 6
Sectoral diversification and exchange rate regime choice – cross-sectional estimation with identification-through-heteroskedasticity.

Variables	Diversification based on sectoral value added share			Diversification based on sectoral employment share		
	(1)	(2)	(3)	(4)	(5)	(6)
div	1.837	−5.363**	−4.558***	−1.065	−6.242***	−0.777
	(1.862)	(2.261)	(1.649)	(1.565)	(1.380)	(2.028)
div*corrup	0.096	1.045*		0.873**	1.036***	
	(0.426)	(0.557)		(0.362)	(0.376)	
div*shock	−0.175***		−0.086**	−0.096***		−0.133***
	(0.034)		(0.039)	(0.035)		(0.039)
corrup	1.254**	0.611		−0.120	−0.055	
	(0.490)	(0.662)		(0.428)	(0.469)	
shock	0.174***		0.087*	0.093***		0.127***
	(0.034)		(0.044)	(0.034)		(0.036)
No. of observations	91	91	92	97	97	97
Over-ID Test, *p*-val	0.245	0.146	0.386	0.176	0.038	0.147
Joint Sig. (*F*-stat, *p*-val.)	13.40 (0.00)	2.82 (0.07)	15.48 (0.00)	13.78 (0.00)	11.59 (0.00)	17.38 (0.00)

Notes: Robust standard errors in parentheses. All regressions include initial income per capita and its square, initial trade openness, log population, dummies for oil exporting countries, landlocked countries, colonial origins, and a constant. The estimation method is identification-through-heteroskedasticity a la Lewbel (2012). Joint sig. refers to the joint significance test of the coefficients of diversification and the interaction term(s). Over-ID test is the Hansen test of over-identification.

*** Statistical significance at the 1% levels.

** Statistical significance at the 5% levels.

* Statistical significance at the 10% levels.

suggesting that the findings are not influenced by these countries. In sum, our results remain robust to excluding countries that might give rise to omitted variable bias and therefore are not sensitive to the sample selection.[26]

5.4. Cross-sectional analysis with alternative identification

Table 6 presents the cross-sectional results employing the heteroskedasticity-based identification. It is worth mentioning that the cross-sectional data, averaged over a long time span, might reveal the longer-term relationships, whereas the previous results based on the pooled panel data can be interpreted as the short-run effects.

Columns (1)–(3) and columns (4)–(6) report findings with diversification based on sectoral value added and employment, respectively. For each measure, the 'horse race' model and the models with individual channels are reported.[27] It can be seen from the results that, in general, either corruption or shock channel or both are significant, and the signs are in line with those obtained by the standard IV estimation. There is also evidence that the shock channel is moderately stronger. In sum, these cross-sectional results broadly support the previous pooled panel results.

5.5. The marginal effect of diversification on regime choice

The results presented so far focus only on point estimates. They do not inform us about the marginal effect of diversification (and hence, the economic meanings of the coefficients have not been discussed). We now discuss the marginal effects to decipher the effects of diversification on regime choice conditional on the values of corruption and shock. We construct confidence intervals (CI) of the marginal effects from the 'horse race' models in Table 3 based on the IV estimations. The marginal effects and their CIs are displayed in Figs. 1(a) and 2(b). In all figures, a solid line represents the marginal effect of diversification over the varying levels of external shock or corruption. For the marginal effect to be statistically significant, the upper and lower bounds of the CI (i.e., the dashed lines) should be simultaneously either above or below the horizontal line drawn at zero.

5.5.1. Diversification, external shock, and exchange rate regimes

Fig. 1(a), which is based on the results in column 1 in Table 3, displays the marginal effect of diversification conditional on different levels of external shocks when diversification is based on sectoral value added shares. To construct the graph, we keep the level of corruption fixed at its mean and let the levels of external shock vary. The figure shows that the statistically significant range of the marginal effect of diversification is always negative, meaning a higher tendency to opt for flexible regimes. This effect

[26] Including dummies for these countries in the main regressions does not change the results. Because these intercept dummies do not satisfactorily address the endogeneity problem, we take the approach of excluding the respective countries from the sample.

[27] For diversification based on value added, the Breusch–Pagan test rejects the null hypothesis of homoscedasticity at the 1% level for diversification and the two endogenous interaction terms. The null hypothesis is rejected at approximately the 11% level for corruption. For the employment-based measure, the null hypothesis is rejected at the 1% level for the two interaction terms, at the 8% level for corruption, and the 15% level for diversification. Overall, we interpret this evidence as favorable for the needed exogenous variation in the first-stage.

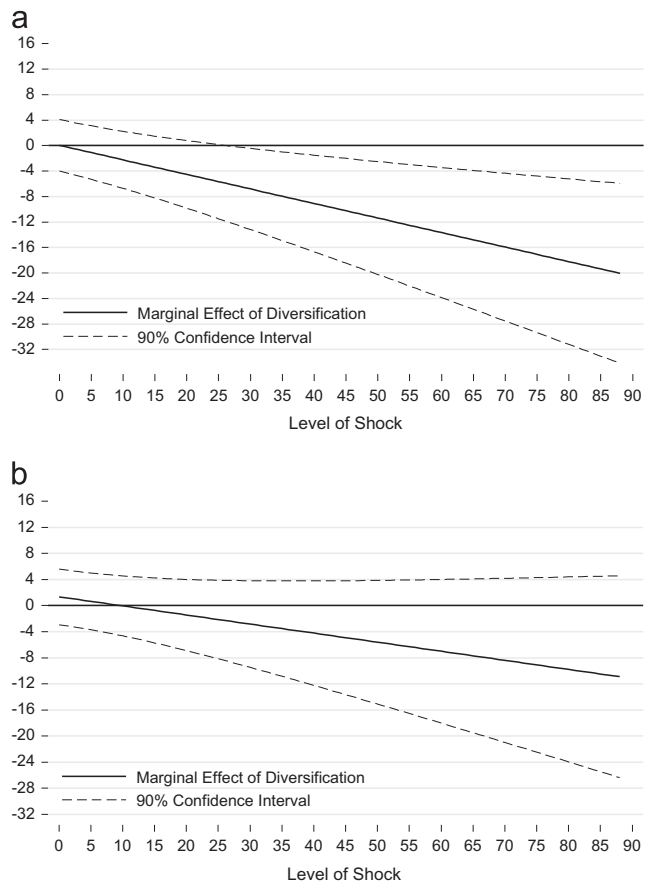

Fig. 1. (a) The effect of sectoral diversification (value added based) on exchange rate regime choice conditional on the levels of external shock. *Note*: Countries for which diversification leads to flexible regimes at higher levels of external shock are Algeria, Angola, Bolivia, Brunei, Burundi, Central African Republic, Chile, Congo (Republic), Cote d'Ivoire, Dominican Republic, Ecuador, Egypt, El Salvador, Gabon, Ghana, Guatemala, Haiti, Indonesia, Malawi, Mexico, Myanmar, Niger, Nigeria, Papua New Guinea, Peru, Poland, Qatar, Saudi Arabia, Sudan, Togo, Uganda, Venezuela, and Zambia. (b) The effect of sectoral diversification (employment based) on exchange rate regime choice conditional on the levels of external shock.

increases in absolute value with external shock, suggesting that the marginal effect is larger for countries experiencing greater shocks. Nevertheless, the figure also indicates that this effect is not significant at very low levels of external shock because it is significant only when external shock exceeds the value of 27 (recall that external shock is measured by the standard deviation of terms-of-trade). The list of countries for which the said effect is significant is provided below Fig. 1. It can also be seen that these countries, which are predominantly emerging and developing, are relatively concentrated; the mean value of their diversification as measured by the Theil index based on sectoral value added shares is 1.27, which is higher than the sample mean of 0.83. Fig. 1 (b), which is based on column 4 in Table 3, shows that when the diversification measure is based on employment share, the magnitudes of the marginal effects remain similar; however, the confidence intervals become wider. As discussed in Section 5.2, this is likely due to the lesser variation in employment shares.

5.5.2. *Diversification, rent-seeking and exchange rate regimes*

The marginal effect of diversification at different levels of corruption holding external shock constant at its mean is displayed in Fig. 2(a) (which is based on column 1 in Table 3). It can be observed that the marginal effect of diversification is initially large and negative and steadily increases afterward as the value of the corruption index increases (indicating less corruption). This increase reflects the significant interaction between diversification and corruption. However, the statistically significant range of marginal effects is associated with a corruption index below 1.5 (indicating widespread corruption). In this range, the magnitude of the negative marginal effect becomes smaller as corruption decreases. The implication of this finding is that the co-existence of rent-seeking opportunities (as proxied by higher levels of corruption) and lower levels of diversification are associated with more fixed regimes. The countries in this category (with a corruption index less than 1.5) are predominantly developing and are listed below Fig. 2.[28]

[28] Of the 46 countries in the list, 32 consistently had a corruption score below 1.5 for at least four years.

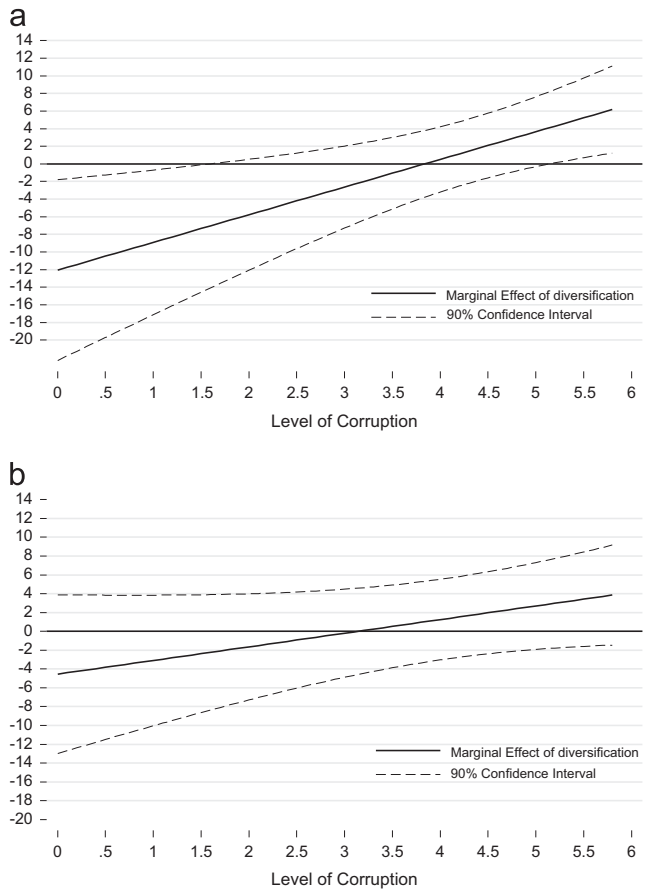

Fig. 2. (a) The effect of sectoral diversification (value added based) on exchange rate regime choice conditional on the levels of corruption. *Note*: Countries for which diversification leads to flexible exchange rate regime at higher levels of corruption (lower corruption index) are Albania, Algeria, Armenia, Bahamas, Bangladesh, Bolivia, China, Columbia, Congo (Democratic), Costa Rica, Cote d'Ivoire, Egypt, Gabon, Guatemala, Guyana, Haiti, India, Indonesia, Iraq, Jamaica, Kazakhstan, Kenya, Lebanon, Liberia, Mali, Moldova, Montenegro, Mozambique, Myanmar, Namibia, Niger, Nigeria, Pakistan, Papua New Guinea, Paraguay, Philippines, Russia, Sierra Leone, Sudan, Syria, Thailand, Togo, Uganda, Ukraine, Vietnam, and Zimbabwe. (b) The effect of sectoral diversification (employment based) on exchange rate regime choice conditional on the levels of corruption.

Table A1
Reinhart and Rogoff (2004) fine exchange rate regime classification.
Source: Reinhart and Rogoff (2004).

Category	Exchange rate arrangements/regimes
1	No separate legal tender
2	Pre-announced peg or currency board arrangement
3	Pre-announced horizontal band that is narrower than or equal to +/−2%
4	De facto peg
5	Pre-announced crawling peg
6	Pre-announced crawling band that is narrower than or equal to +/−2%
7	De facto crawling peg
8	De facto crawling band that is narrower than or equal to +/−2%
9	Pre-announced crawling band that is wider than or equal to +/−2%
10	De facto crawling band that is narrower than or equal to +/−5%
11	Moving band that is narrower than or equal to +/−2% (i.e., allows for both appreciation and depreciation over time)
12	Managed floating
13	Free floating
14	Freely falling (Hyper-float)

An additional finding that needs attention in the figure is that the marginal effect of diversification becomes positive when the corruption index reaches a value of 5.2 or higher. This means that countries with high levels of concentration coupled with the absence of (or limited) rent-seeking opportunities are associated with more flexible regimes. The overall

Table A2
Variables and data sources.

Variables	Description	Data source	Time period
regime	Exchange rate regime choice. Reinhart–Rogoff fine classification (1 to 14 scale). Higher values indicate more flexible regimes.	Ilzetzki et al. (2008)	1970–2007
div	Sectoral diversification – Theil Index and Herfindahl index, constructed by the authors using sectoral value added and employment shares. Higher values of the index indicate lower levels of diversification (higher concentration).	INDSTAT2 2012 Rev.3, UNIDO	1963–2009
shock	The standard deviation of the terms of trade defined as the ratio of the export unit value indexes to the import unit value indexes, measured relative to base year 2000.	WDI	1985–2007
corrup	Corruption, as proxy for rent-seeking. 0 to 6 scale. Higher values indicate lower levels of corruption.	International Country Risk Guide	1985–2006
open	Trade openness, defined as the share of export and import of goods and services in GDP.	Penn World Tables v. 6.2	1970–2007
income	Log of per capita real GDP in USD.	Penn World Tables v. 6.2	1970–2007
lpop	Log population.	WDI	1970–2007
landlocked	Dummy for landlocked countries.	CIA World Fact Book	
colonial origin	Dummies for colonial origins.	La Porta et al. (1999)	
protestant	Percentage of protestant population.	La Porta et al. (1999)	
oil	Dummy for oil exporting countries.	The World Bank	

Table A3
First-stage and reduced form regressions.

Variables	Diversification				Corruption	
	First stage		Reduced form		First stage	Reduced form
	(1) div Value added based	(2) div Employment based	(3) regime	(4) regime	(5) corrup	(6) regime
20-year lag Div	0.524*** (0.145)	0.449*** (0.087)	−1.193 (1.223)	−0.845 (1.137)	–	–
Protestant	–	–	–	–	0.016*** (0.003)	0.025 (0.017)
Country	76	78	76	78	99	99
Observations	969	995	969	995	1,755	1755
R-squared	0.731	0.717	0.166	0.147	0.534	0.193
F-stat	13	26.64			35.72	
Shea partial R2	0.20	0.18			0.09	
Under ID Test (*P*-val)	5.95 (0.01)	9.91 (0.00)			13.03 (0.00)	

Notes: Robust standard errors clustered at the country level in parentheses. The dependent variable for each regression is specified under the column number. All regressions include the lag of income per capita and its square, the lag of trade openness, log population, dummies for oil exporting countries, landlocked countries and colonial origins, and a constant. *F*-stat refers to the first-stage *F*-statistics on the excluded instrument. Under-identification test refers to the Kleibergen-Paap rk LM statistic and its *p*-value.

*** Statistical significance at the 1% levels.

implication of this finding is that efficient and competitive production, even if it is concentrated,[29] combined with low corruption can mitigate the 'fear of floating'. This diminutive effect can be attributed to lesser or virtually no political incentive to exploit rents in such settings. In these economies, the benefits of a flexible exchange rate regime would be likely to accrue to broader citizenry rather than to a few elites. In our sample, these countries are developed and characterized by low levels of corruption; they include Canada, Denmark, Finland, Germany, Iceland, the Netherlands, Sweden, and the UK. Fig. 2(b), which is based on column 4 in Table 3, shows that when diversification is based on sectoral employment share, the confidence intervals are wider, rendering the marginal effect insignificant.

In an unreported analysis, we find that the CIs based on cross-sectional results yield similar patterns as in the case of the pooled panel; however, the threshold values for corruption and shock are different. For instance, in the case of diversification that is based on value added, the marginal effect of diversification is negative and significant when the external shock is larger than 21 (compared with 27 for the pooled panel) and when the corruption index is lower than 3.8 (compared with 1.5 for the pooled panel).

To summarize, the marginal effect of diversification on exchange rate regime choice is significant for countries that experience greater external shocks and are characterized by relatively high corruption levels. In both cases, a higher level of

[29] Re-concentration can also be the result of agglomeration or increasing returns to scale in addition to higher income level.

diversification (concentration) leads to flexible (fixed) regimes. The results are statistically stronger when the diversification measured is based on sectoral value added than on employment shares.

6. Conclusions

This study examines the effect of sectoral diversification on exchange rate regime choice using a panel dataset covering 91 countries over the period 1985–2006. It provides illuminating evidence on the pathways through which the changing production patterns in the real sector can shape one of the central macroeconomic policies of a country. The paper identifies two mechanisms through which diversification and regime choice may be related, namely, the external shock absorption and rent-seeking mechanisms. Together with a hypothesized direct effect, the paper then runs a 'horse race' among the

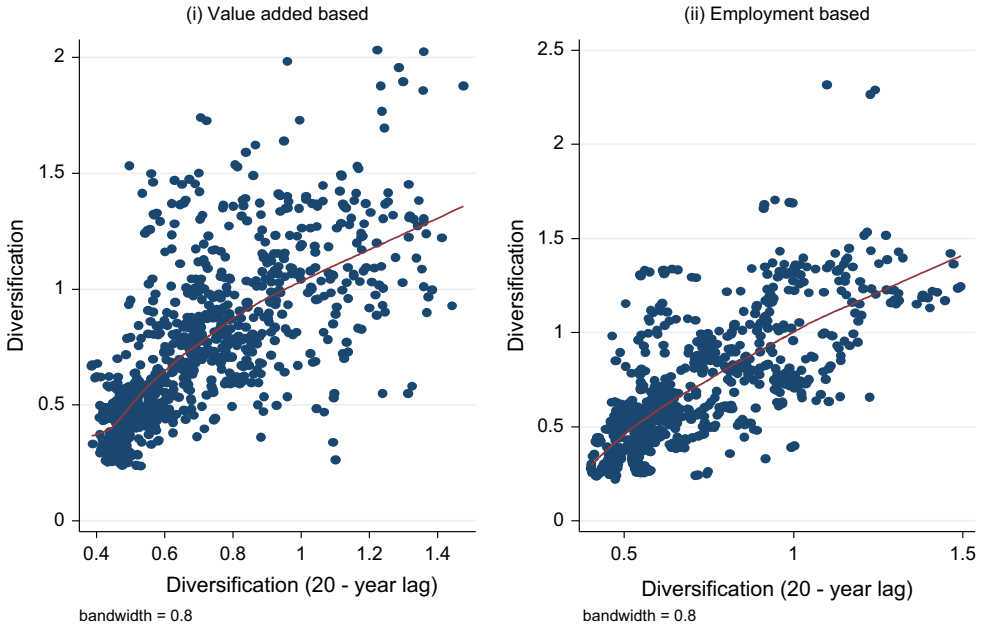

Fig. A1. The relationship between sectoral diversification and its 20-year lag – non-parametric fit.

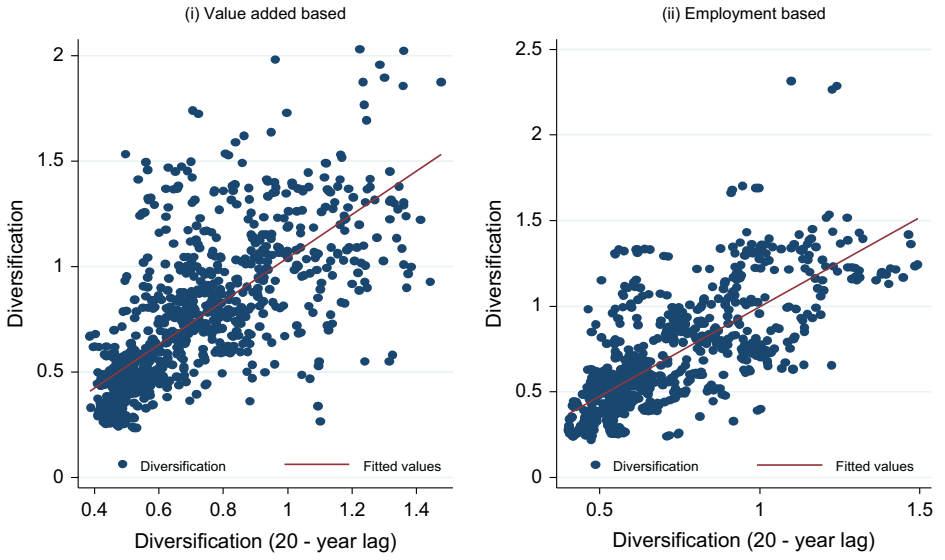

Fig. A2. The relationship between sectoral diversification and its 20-year lag – linear fit.

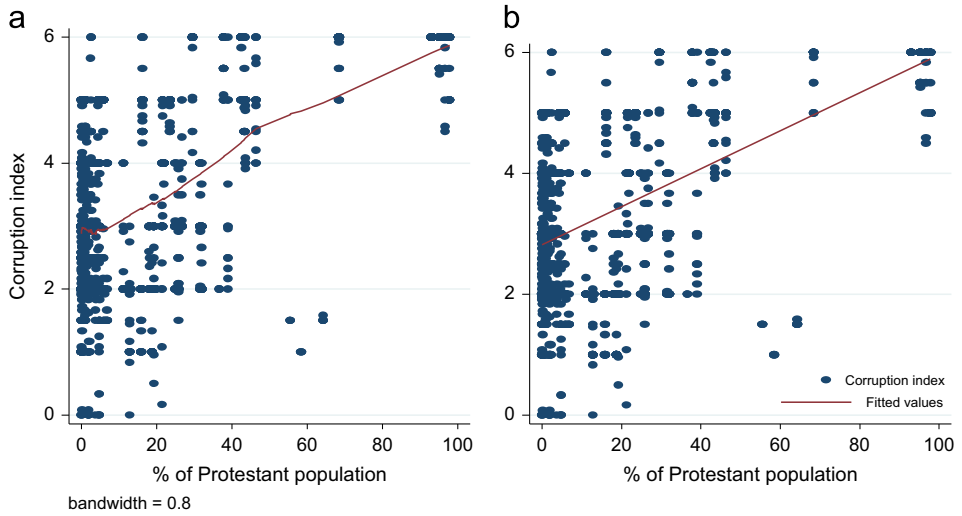

Fig. A3. The relationship between corruption and the percentage of the Protestant population – (a) nonparametric and (b) linear fits.

identified mechanisms. Several approaches have been employed to address the endogeneity of diversification and rent-seeking, including instrumental variable estimation and heteroskedasticity-based identification.

The results point to a direct effect of sectoral diversification on flexible regimes, albeit statistically weak, implying that a diversified production pattern in the economy might provide protection against the 'fear of floating.' The findings also reveal strong interaction effects in that diversification affects exchange rate regimes through a rent-seeking or corruption channel. For countries besieged with higher levels of corruption, lower sectoral diversification is associated with fixed regimes. This result is tantamount to increased protection for the powerful elites from international competition. There is also strong evidence for the external shock mechanism in that diversification enables a flexible exchange rate regime in countries experiencing greater external shocks. We therefore conclude that sectoral diversification affects exchange rate regime choice through its interactive relationship with rent-seeking and external shock absorption. Given the difficulties associated with establishing the true causal effects in cross-country data, our results can be interpreted as robust correlations among possible markers of the exchange rate regime choice.

Finally, the study contributes to a deeper understanding of the concept of diversification and its interactions with other variables in shaping a key macroeconomic policy choice. In view of the recent surge in interest for diversification and its links with, among others, economic development, structural change, volatility and productivity growth, we believe that the mechanisms put forward in this paper can shed light on the appropriate policy options for countries at different stages of productive capacity and institutional development.

Appendix A

See Appendix Tables A1–A3 and Figs. A1–A3.

Appendix B. Supporting information

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.euroecorev.2014.02.001.

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